STOCKHOLM SCHOOL OF ECONOMICS

Weary Workers
or
Poor Pensioners

A Study of the Swedish Pension System

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This paper examines the stability of the Swedish pension system. Specifically, we ask how much demographic and financial factors influence the balance ratio in the Swedish pension system. Using simulations, four demographic scenarios, two policy changes and four aspects of the buffer fund are tested. We find that demographic factors have a large impact on the long term stability, with the buffer fund serving an important role of neutralising variations in demographic factors. In more detail, an increase in the number of pensioners and an increased longevity put strain on the pension system. However, these can be counteracted with policy changes, where delayed retirement age has the largest effect. On the other hand, increased immigration and birth rates have a positive effect on the pension system, in the short term and long term respectively. Increased return in the buffer fund has a smaller positive effect on the balance ratio, and changes in costs have limited effect on the balance ratio. An increase in the size of the buffer fund can however enhance the effect of the neutralising mechanism that the buffer fund constitutes. The asset allocation affects the buffer fund's ability to recover after turbulence in the market and is hence important to take into consideration when looking at the effects of financial factors. The results confirm that the Swedish pension system, which is a Pay-As-You-Go system, is highly sensitive to changes in demographic factors and not as sensitive to changes in financial factors. Increasing the size of the buffer fund would represent a shift toward a more funded system. While this entails risk, it could decrease the sensitivity of the system to changes in demographic factors and also increase the magnitude of the buffer fund as a neutralising mechanism.

Keywords: Pension System, Pay-As-You-Go, Balance Ratio, Demographic and Financial Factors

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I. Introduction

With an ageing population across the globe, pensions have become a widely discussed topic. As the population grows older, fewer workers have to support an increasingly large group of pensioners. High unemployment among young workers and decreased birth rates are other important concerns for pension systems.

The performance of the National Pension Funds (Swe. AP-fonderna) during the financial crisis has intensified the focus on the Swedish pension system. However, while the National Pension Funds are an important factor to neutralise economic and demographic variation, there is a limit to the extent that they can cover potential deficits in the Swedish pension system.

Around Europe, pensions have caused great controversy and there have been several nationwide strikes in recent years. In 2010, 3 million people in France participated in a strike against raising the minimum retirement age from 60 to 62 and the age to be entitled to a full pension from 65 to 67. This was the biggest one-day strike in years and 70% of the public supported the strike (Marliere, 2010). Another example is Greece, where millions took part in nationwide strikes against the pension reforms in 2008 (BBC NEWS, 2008).

The structure of pension systems, retirement age and retirement conditions have hence been given more space in the public debate and pensions have become an important political question in Sweden. Even though the system went through a transformation in 1999, to take the form it has today, there is still debate about the Swedish pension system and the implications for pensioners.

Sweden currently has a Pay-As-You-Go (PAYG) system, which means that current workers pay for current pensioners (Government Offices of Sweden, 2004). While Sweden is already ahead in terms of the development of the public pension system, improvements can still be made. For the PAYG system to work, the confidence in the system and in each person getting their pension when retired, has to prevail. To ensure this, the Swedish pension system is designed in a way that the balance between assets and liabilities should always be maintained. When the balance ratio between the pension asset and pension liability falls below 1.00 the automatic balancing is activated, decreasing the pension disbursements (The Swedish Pensions Agency, 2011a). As the Swedish pension system is designed this way it is of great interest and importance to simulate scenarios possibly disrupting the balance. Demographic, economic (such as wage development, inflation, unemployment etc.) and financial factors (such as performance of stock markets, asset allocation etc.) can all potentially affect the balance ratio. To look at economic factors, the model would need to be developed further. Hence, we will focus on the effects of demographic and financial factors.

The question we aim to answer is:

How much will changes in demographic or financial factors affect the balance ratio in the Swedish pension system?

The remainder of this paper is organised as follows. Section II gives an overview of previous research. Section III covers the structure of the Swedish pension system. The methodology is described in Section IV. Section V describes the data. Empirical findings are presented in Section VI. The limitations of the model and data are discussed in Section VII. Finally, concluding remarks are offered in Section VIII.

II. Previous Research

The research performed in the field of pensions is extensive. Bovenberg (2003) argue that while ageing constitutes an important factor affecting the sustainability of pension systems, it has also become clear that ageing in turn makes the pension systems more vulnerable to changes in asset prices.

A. Ageing in the Population

Around the world the population is ageing. Two critical trends; increasing median age and population decline, will potentially cause problems in several areas of social, political and economic life. An area particularly affected by population age structure is pension policy. According to Bonoli & Shinkawa (2005) these trends will collectively put higher pressure on the younger generations, supporting an increasingly large group of pensioners.

As seen in Table 1, the pace at which the demographic structure changes varies substantially between geographic areas. While in Western Europe the pace at which population is ageing is moderate, East Asia is experiencing a much higher pace of transition. This has increased the pressure in the political debate and many reforms have been undertaken in Western Europe. As the starting point was much lower in South Korea and Taiwan, the age structure will not reach that of Western Europe until 2040. However, in Japan the change has been rapid and the ageing problem is expected to be one of the worst in the world in the coming years. In North America the pace of population ageing is moderate. The US is not expected to experience as much of a problem as in other countries and there has hence not been any major reforms (Bonoli & Shinkawa, 2005).

Table 1 - Proportion of Population Aged 65 or Over

The proportion of population aged 65 or over is presented for a number of European, Northern American and East Asian countries. Both historical values for 1980 and 2000 are provided, as well as predictions for 2020 and 2040.

Country	1980	2000	2020	2040
France	14.0%	16.2%	20.1%	25.1%
Germany	15.5%	16.0%	21.6%	30.7%
Italy	13.4%	18.2%	23.7%	33.1%
Sweden	16.3%	17.4%	23.0%	26.8%
Switzerland	na	15.2%	23.3%	31.4%
United Kingdom	14.9%	16.0%	20.0%	25.6%
Canada	na	12.5%	18.7%	26.8%
United States	11.2%	12.7%	17.0%	22.4%
Japan	9.1%	17.2%	27.2%	31.5%
South Korea	3.8%	6.7%	13.0%	24.6%
Taiwan	4.4%	8.6%	13.2%	19.9%

Source: Bonoli &Shinkawa, 2005

B. Pension Systems Around the World

The pattern of population ageing together with the structure of the pension system, and to some extent also the political system as a whole, leads to different policies being adopted in different countries (Bonoli & Shinkawa, 2005). Hence, the pension systems have multiple characteristics that can vary between countries. Examples of these characteristics are;

(1) to which extent pensions are earnings-related,
(2) if pensions are public or private,
(3) whether pension schemes are based on defined benefit or defined contribution,
(4) and the funding of the systems (in terms of the systems being mostly pre-funded or Pay-As-You-Go).

Looking at to which extent pensions are earnings related, it varies substantially between countries. In Germany, France, Italy and Sweden pension provisions are earnings-related, while in the UK, the Netherlands, Denmark and Switzerland pension provisions are only moderately earnings-related. The first group of earnings-related type of pension systems can be referred to as social insurance pension systems. In the latter group, referred to as multipillar countries, pensions are only intended to cover basic needs and to prevent poverty in the older population. A third category including the US, Canada and Japan have earnings-related pensions, but at a lower level. These can be referred to as Bismarckian Lite countries (Bonoli & Shinkawa, 2005).

In multipillar countries, where pensions have not been as earnings-related, occupational and private pensions have developed as complements. This development has only been observed recently in the social insurance countries (Bonoli & Shinkawa, 2005). Stewart & Hughes (2009) find that recent changes in the pensions systems have resulted in a gap between expected and projected income during retirement, which has been filled by occupational pension schemes and private pension accounts.

The ageing of the population has also caused many countries, e.g. Sweden, Poland and Italy, to abandon the defined benefit schemes, in favour of the defined contribution schemes (Stewart & Hughes, 2009). The same trend, moving from defined benefit to defined contribution schemes can also be found in Japan, Canada and the US (Bonoli & Shinkawa, 2005). The transformation of pension systems from defined benefit to defined contribution places an increased burden on the employee to ensure that the individual pension savings are adequate. However, even though the voluntary savings are becoming an increasing part of pension provisions, employers have great influence over individual savings, as employees are likely to follow the path of least resistance. The default choice in terms of saving rates and investment funds tend to be the choice of most employees. Even when they are faced with the opportunity to opt out, they rarely do. This is called passive decision-making and means that employers, and in a sense governments through policy-making concerning occupational pension schemes, have great influence over individual pension savings (Choi, Laibson, Madrian & Metrick, 2002).

There are also trends in the funding of the pension systems, related to other characteristics. The social insurance countries are often funded on a Pay-As-You-Go (PAYG) basis. This makes them very sensitive to changes in demographics. In the Bismarckian Lite countries the problems are expected to be of lesser extent because of the smaller size of the state pension. The perception of the public in these countries is that the occupational pensions are not the State's responsibility. However, in multipillar countries the private pensions have come to be conceived in a similar way as public pensions. For that reason the demographic changes will impose a problem for the State in these countries. Still, multipillar countries (where pension systems are financed with a combination of PAYG and pre-funded) are less sensitive to demographic changes as they are not subject to intergenerational transfer to the same extent (Bonoli & Shinkawa, 2005). On the other hand, privately funded pension schemes are only more secure as long as there is no dramatic drop in the value of assets. The collapse of the French funded schemes during the interwar period is one example of such an event (Stewart & Hughes, 2009). Other studies confirm that systems financed on a PAYG basis are more vulnerable to a decline in the worker/retiree ratio, but emphasises that the problem also affects funded schemes as labour become relatively more scares than capital, hence depressing asset prices and the return on capital (Bovenberg, 2003).

Looking at the Swedish pension system, pensions are earnings-related and public to a large extent. The system has also been transformed to a defined contribution system, where the largest part is financed on a PAYG basis.

C. Pensions and the Financial Markets

The structure of the system makes it sensitive to changes in demographic factors. Furthermore, pension systems become more sensitive towards risks, such as unexpected increases in longevity or lower asset prices, when the contribution base decreases compared to the outstanding pension obligations. Bovenberg (2003) point out that diversification hence becomes more important.

As discussed by Bogle (1994), asset allocation accounts for 94% of the difference in return in institutionally managed pension portfolios. Studying UK pension funds it has been shown that long-term strategic asset allocation accounts for variations in portfolio returns, while market timing and security selection have little explanatory value (Blake et al, 1999).

III. The Swedish Pension System

A. A Breakdown of the Swedish Pension System

The Swedish pension system consists of three parts; *public pension* provided by the Swedish Pensions Agency (Swe. Pensionsmyndigheten), *occupational pension* from the employer and *private pension savings*. The three parts collectively represent each person's total pension asset (The Swedish Pensions Agency, 2011b).

Public Pension

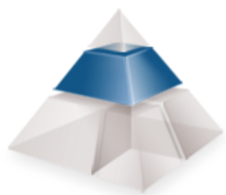
The public pension system is a Pay-As-You-Go (PAYG) system, which means that the current pension contributions finance the current pension disbursements. The pension balance (Swe. pensionsbehållning) built up during the years of working is the basis for the calculation of income pension during retirement. The amount of pension credit (Swe. pensionsrätter) earned each year is registered in the system. The pension credits are registered in each person's pension account, but there are no actual money on the account since the pension system is a PAYG system. The account shows the right to future pension, the pension balance, which has an growth that reflects the development in average income in Sweden through the income index. The age of retirement is 65, at which age one is entitle to full pension. However, the minimum retirement age, which is the earliest age one can choose to retire, is 61 (Government Offices of Sweden, 2004).

Each year 18.5% of wages and other taxable benefits are set aside for the public pension. Of these, 16% go to the income pension (represented by dark orange in the picture) and 2.5% go to the premium pension (represented by bright orange in the picture). The income pension grows with the development of average income in Sweden, while the value of the premium pension changes in accordance with the performance of the funds, in which the pension is invested (The Swedish Pensions Agency, 2011b). For the premium pension, the Seventh National Pension Fund, will manage the holdings of those who have not actively made a choice of investment (The Swedish Pensions Agency, 2011a). A registered partner or a husband/wife can in the case of a deceased partner, be transferred the premium pension entitlement (The Swedish Pensions Agency, 2011b), while the income pension will accrue the pension system to be used for pension disbursements (Government Offices of Sweden, 2004).

In addition to earned income, certain non-income earnings entitle pension credit. Pension-qualifying amounts (Swe. pensionsgrundande belopp) may be based on years of staying home taking care of children, sick leave, received activity compensation, military duty or higher education. The ceiling on pension-qualifying income (Swe. intjänandetak) is 7.5 income-related base amounts (The Swedish Pensions Agency, 2011b). This is the highest possible income for which pension credits are earned. Above this income level, 18.5% of wages and other taxable benefits will accrue solely the central-government budget (The Swedish Pensions Agency, 2011a).

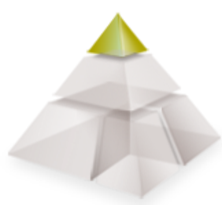
Occupational Pension

The second part of the Swedish pension system is the occupational pension, obtained by a majority of the working population. Each month employers set aside occupational pension for their employees, to their personal pension accounts. Age pension (Swe. ålderspension), survivor's protection (Swe. efterlevandeskydd) and health insurance, (Swe. sjukförsäkring) are the basic parts of the occupational pension. Neither self-employed, students nor unemployed receive occupational pension (The Swedish Pensions Agency, 2011b).



Private Pension Savings

The third part of the Swedish pension system is the private pension savings. This is optional and thus up to each individual to decide upon if it is necessary. The private pension saving could be held at a bank or an insurance company (The Swedish Pensions Agency, 2011b).



Other Pension

Guaranteed pension (Swe. garantipension) is part of the public pension and financed by taxes. People who have had low or no income are entitled to guaranteed pension when retiring. Though, the person must have lived in Sweden for 40 years to receive a full guaranteed pension (The Swedish Pensions Agency, 2011b).

Supplementary pension, which is based on the income earned during years of working, is a remnant from the old public pension system. People born between 1938-1953 receive part supplementary pension and part income/premium pension and people born before 1938 receive only supplementary pension. (The Swedish Pensions Agency, 2011b).

B. The Balance Ratio

Each year assets and liabilities are valued in the PAYG-system. The total pension asset is made up by the contribution asset (Swe. avgiftstillgången) and the average value of the buffer fund. The contribution asset consists of the contribution revenue and grows in line with the development in average income. Employers, employees and in certain aspects the Government are obligated by law to pay pension contributions. These collectively make up the contribution revenue. Stocks, bonds and other securities make up the assets in the buffer fund. The growth of the buffer fund is due to the return on capital and the net contribution (Swe. avgiftsnettot). The net contribution is zero when the contributions are equal to the pension disbursements, in a given year. The return on capital then alone accounts for the growth of the fund. The total pension liability gradually increases as the pension balance (Swe. pensionsbehållningen) increases. At the same time, the total pension liability decreases as pensions are disbursed (Government Offices of Sweden, 2004).

Each year the balance ratio is calculated by setting the total pension asset in relation to the total pension liability. If the liability exceeds the asset, the balance ratio falls below 1.00. To restore the balance between the asset and liability, the income index is replaced by a balance index. The growth in pension credits (Swe. pensionsrätt) and the conversion of pension disbursements are hence lower and the growth in the total pension liability is held back (Government Offices of Sweden, 2004). This is however realised with a two-year delay, meaning that if the balance ratio falls below 1.00 in a certain year the automatic balancing mechanism is activated two years later (The Swedish Pensions Agency, 2011a).

When the balance ratio exceeds 1.00 after one or a few years, the balance index approaches the level of the income index. The balance index is used until it reaches the same level as the income index. The annual growth with the balance index will be higher than what would have been the case if the income index was used, during the years when the balance ratio once again exceeds 1.00. The level of pension disbursements is restored to the level they would have had with a sustained income indexing, since the annual growth during the latter part of the balance period is higher. The value of the pension credits, earned when the balance was activated, is also restored because of the higher indexation. In addition, the pension credits earned during the latter part of the balance period are higher than if applying the income index. Workers therefore benefit from the balance period. Even though the level of pension disbursements are restored after the balance period, the reduction in pension disbursements which occurred during the balance time is not compensated for (Government Offices of Sweden, 2004).

The automatic balancing mechanism eliminates the risk of the buffer fund permanently being emptied, which is necessary to ensure that the system has the characteristics sought in the reform (Government Offices of Sweden, 2004).

C. The Buffer Fund

The difference between the contribution revenue (Swe. avgiftsinkomst) and pension disbursements is to be handled by the buffer fund. The value of the buffer fund grows during years when the contribution revenue is larger than the pension disbursements, to be able to finance pension disbursements during periods when the contribution revenue is smaller than the pension disbursements (Government Offices of Sweden, 2004). Hence, the buffer fund has a balancing effect to neutralise demographic or economic variation in the system (The Swedish Pensions Agency, 2011a).

The First-Fourth and the Sixth National Pension Funds (Swe. AP-fonderna) together make up the buffer fund. While the contribution revenue and the pension disbursements are split equally between the First-Fourth National Pension Funds, there is neither inflow nor outflow from the Sixth National Pension Fund (The Swedish Pensions Agency, 2011a).

The result of the buffer fund, has however not been satisfactory according to the Government Offices of Sweden (2009). While the downturn in 2008 can explain much of the decrease in capital, the targets for the investment management have not been met over a period of several years. There are hence initiatives to investigate the strategic management and costs of the buffer fund.

In addition to the discussion regarding the return and cost of the buffer fund, there has been much debate in media regarding the investigation of the optimal number of buffer funds. It has been discussed whether it would be more efficient to merge the National Pension Funds included in the buffer fund into one or two funds instead of five. Lower costs and hence higher returns are central arguments for a merge. The fact that other countries with similar pension systems have one pension fund is also an indicator that a merge would be preferable. On the other hand, the loss of competition between the National Pension Funds is an argument against such a merge. When the number of funds was originally decided upon, the fact that different National Pension Funds could choose different investment strategies, which would increase the diversification in the pension system, was considered important (Cervenka & Almgren, 2009).

The First-Fourth National Pension Funds

16% of the monthly pension contributions that constitute the income pension are deposited in the First-Fourth National Pension Funds. The monthly disbursements are paid out from the same funds (The Swedish Pensions Agency, 2011a).

Although the First-Fourth National Pension Funds are separate funds, they all abide under the same investment rules, which are the following:

- All instruments occurring in the capital market that are quoted and marketable may be invested in.
- Interest-bearing securities with low risk shall appoint for at least 30% of investments.
- The exposure to currency risk may not exceed 40% of assets.
- Each fund's ownership in a single listed company may not exceed 10% of the voting power.
- The portion of investments in unlisted securities may not exceed 5% of fund assets. Security funds or the like must make these investments.
- External asset managers have to manage at least 10% of fund assets. (AP3, 2011b)

As can be seen in Table 2 the allocation between asset classes among the First-Fourth National Pension Funds are similar.

The Sixth National Pension Fund

The Sixth National Pension Fund is unique in that there is no capital in- or outflow from the fund from contribution revenue or pension disbursements. This means that the return from previous investments is reinvested as new private equity in other companies and that costs and capital requirements are to be carried by the fund itself. In 1996 the fund was given SEK 10.4 billion and has since then been committed to managing that capital. The goals of the fund are:

- High long-term return
- Satisfying risk-level
- Capital allocated in small and medium size companies (AP6, 2011)

In terms of the goals of high long-term return and meeting the requirements for a satisfying risk level there is no difference from the goals of the First-Fourth National Pension Funds. However, the means by which the goals are reached are different. The allocation of capital is to be only in small and medium size, and mainly Swedish, companies. In this way the fund contributes to the development of the Swedish business environment (AP6, 2011).

The investment rules of the Sixth National Pension Fund are much looser than those of the First-Fourth National Pension Funds, but the fund cannot:

- Acquire more than 30% of shares in a company that is traded outside the European Economic Area (EEA), or 30% or more of the voting power in such a company. Acquisition of shares in a Swedish or foreign venture capital firm is not to be followed by this rule.
- Have exposure to currency risk that exceeds 10% of the fund's assets, valued at market value (AP6, 2011).

The allocation of assets in the buffer fund in 2010 can be found in Table 2.

Table 2 - Allocation in the National Pension Funds

For each of the First, Second, Third, Fourth and Sixth National Pension Fund, which are the funds included in the buffer fund, a specification of assets and liabilities is provided. The total assets and liabilities in the buffer fund are also specified.

Fund Assets 31 Dec 2010 (MSEK)	**AP 1**	**AP 2**	**AP 3**	**AP 4**	**AP 6**	**Total**
Stocks and shares	135 098	123 825	133 272	125 000	19 884	537 079
Swedish	*36 083*	*50 670*	*37 861*	*43 848*	*19 749*	*188 211*
Foreign	*99 015*	*73 155*	*95 411*	*81 152*	*135*	*348 868*
Bonds and other interest-bearing assets	79 093	85 589	96 338	75 169	262	336 451
Swedish	*36 453*	*49 412*	*38 547*	*38 366*	*262*	*163 040*
Foreign	*42 640*	*36 177*	*57 791*	*36 803*		*173 411*
Derivatives	5 152	9 707	4 317	12 150		31 326
Other assets	4 304	4 472	13 315	3 256	64	25 411
Total assets	**223 647**	**223 593**	**247 242**	**215 575**	**20 210**	**930 267**
Derivatives	-1 396	-912	-1 430	-1 720		-5 458
Others	-3 470	-174	-24 983	-1 019	-282	-29 928
Total liabilities	**-4 866**	**-1 086**	**-26 413**	**-2 739**	**-282**	**-35 386**
Total	**218 781**	**222 507**	**220 829**	**212 836**	**19 928**	**894 881**

Source: The Swedish Pensions Agency, 2011a

D. The Decision-making Parties in the Swedish Pension System

There are several important parties collaborating in the Swedish pension system; the Swedish Pensions Agency, the Parliament, the Ministry of Finance and the Government.

The Swedish Pensions Agency is in charge of the national pension system, both in terms of pension contributions and pension disbursements. The annual value statement, which shows the balances in the income and premium pension accounts, as well as the performance of the chosen premium pension funds, is sent to each person born 1938 or later in an orange envelope.

In addition, a forecast of how much pension that will be received during retirement and a settlement on how much pension credit that has been earned is stated in the orange envelope (The Swedish Pensions Agency, 2011b).

The National Pension Funds have been directed by the Parliament to manage fund assets within the income pension system in such a manner as to achieve the highest possible benefit (Notisum, 2000). Every year the Government evaluates the performance of the National Pension Funds and presents the results to the Parliament. The Ministry of Finance decides upon which companies will assist the Government in the evaluation and which parts of their operations the evaluation should focus on (AP1, 2011).

Managing Directors of the respective funds are appointed by the Fund's Board of Directors, which in turn is appointed by the Government. The Fund's auditors are also appointed by the Government (AP1, 2011).

There are two laws by which the National Pension Funds abide; the National Pension Insurance Funds (AP Funds) Act (SFS 2000:192) and the Sixth AP Fund Act (2000:193). *The National Pension Insurance Funds (AP Funds) Act (SFS 2000:192)* regulates the First-Fourth and Seventh National Pension Funds, which manage insurance funds for income-based retirement pensions. *The Sixth AP Fund Act (SFS 2000:193)* governs the operations of the Sixth National Pension Fund, to manage insurance funds for income-based retirement pensions (Notisum, 2000).

E. The Transformation of the Pension System

The pension system of today originates from the ATP-system that was adopted in 1959. One of the first tasks of the new government in 1991 was to study the pension system, which was under pressure at the time. The aim of the investigation was to come up with reform suggestions that would make the pension system more resistant to changes in the state of the economy, improve the connection between pension contributions and disbursements, and induce people to increase long-term savings. The working party came up with a suggestion to drop the 15-30 rule, where pension disbursements were based on the 15 out of 30 working years with the highest earnings, in favour for a benefit system based on life-time earnings. Pensions being indexed to inflation would gradually make the system collapse with a continued low economic growth. Therefore the working group suggested to use an income index reflecting the development in average income instead (Anderson, 2005).

The National Pension Funds' rules were modified in the pension reform in 1999, by which the National Pension Funds' role as a buffer and long-term financier of the pension system was clarified (Government Offices of Sweden, 2011).

The first, second, fourth, sixth and seventh fund boards changed name to the First, Second, Fourth, Sixth and Seventh National Pension Funds in May 1, 2000. The third fund board was dismantled and the fifth fund board was renamed the Third National Pension Fund, which is why there is currently no Fifth National Pension Fund, (Government Offices of Sweden, 2011).

Through the pension reform the State Budget was strained, because of the transferred commitment to pay guaranteed pension, contributions for pension-qualifying compensations (Swe. pensionsgrundande ersättningar) from social and unemployment insurance, and pension-qualifying amounts (Swe. pensionsgrundade belopp) in the form of early retirement, years with children, studies or military service. It was considered justified to compensate the State Budget for this burden by transferring capital from the buffer fund to the State Budget (Government Offices of Sweden, 2011).

Since the Parliament decided on the automatic balancing of the pension system, the Sixth National Pension Fund has also been included in the income pension system, as part of the buffer fund. However, in the pension agreement in 1999 the Sixth National Pension Fund was not included and has a specialised task compared to the other National Pension Funds (Government Offices of Sweden, 2011).

Because of the transformation of the system, risks such as market volatility, bad performance in the Swedish business environment, and changes in demographics has been shifted from the State, and thus tax payers, to pensioners (Anderson, 2005).

IV. Methodology

Simulations of the pension system are performed in Stata to test the effect on the balance ratio from changes in variables related to demographic and financial factors. The value of the balance ratio is estimated 10 years ahead, for the years 2011-2020. The model used for this purpose is a simplified version of the model used by the Swedish Pensions Agency, where the values of the variables are provided in nominal terms.

An initial test is performed where we look at the three major components of the balance ratio, for t=2011,…,2020:

$$BR(t) = \frac{\mathrm{CA(t)}+\overline{\mathrm{BF(t)}}}{\mathrm{LT(t)}} \tag{1}$$

where:

BR(t)	=	balance ratio, year t.
CA(t)	=	contribution asset, year t

$\overline{\mathrm{BF(t)}}$ = average value of buffer fund, year t

$\mathrm{LT(t)}$ = pension liability, year t

If the balance ratio computed in year t is below 1.00, the automatic balance mechanism is activated in year t+2. When performing the simulations, considerations are never taken to an activation of the balance mechanism when the balance ratio falls below 1.00.

Simulations using the three major variables are performed to see how much 1% and 5% deviations from the values provided by the Pension Agency affect the balance ratio. The simulations in the initial test are simplified to the extent that the fact, that the value of the buffer fund at time t is determined by the value of the buffer fund at time t-1, as seen in equation (5), is not taken into account.

Each of the three variables making up the balance ratio are then constructed in Stata, to see how the underlying variables affect the balance ratio.

Contribution asset

The first of the three main variables; the contribution asset, is computed for t=2011,…,2020:

$$CA(t) = \overline{ACR(t)} * \overline{TD(t)} \tag{2}$$

where:

$CA(t)$ = contribution asset, year t

$\overline{ACR(t)}$ = adjusted value of the contribution revenue, year t

$\overline{TD(t)}$ = median turnover duration, year t

The value of the contribution revenue is smoothed over three years and adjusted using the CPI. For further variable description see Appendix A.

The median turnover duration is given by the median of the turnover duration in the past three years, for t=2011,…,2020:

$$\overline{TD(t)} = median\ [TD(t-1), TD(t-2), TD(t-3)] \tag{3}$$

where:

$\overline{TD(t)}$ = median turnover duration, year t

$TD(t)$ = turnover duration, year t

The turnover duration is the number of years between the expected average age of earning pension credits (Swe. pensionsrätt) and the expected average time of pension disbursements. The turnover duration is the sum of the pay-in duration and the pay-out duration, for t=2011,…,2020:

$$TD(t) = ID(t) + OD(t) \tag{4}$$

where:

$TD(t)$ = turnover duration, year t

$ID(t)$ = pay-in duration, year t

$OD(t)$ = pay-out duration, year t

The pay-in duration is the number of years between the expected average age of earning pension credits (Swe. pensionsrätt) and the expected average age of retirement. The pay-out duration is the number of years between the expected average age of retirement and the expected average time of pension disbursements.

This can be showed in a simplified example, where the portion of earnings is multiplied with the time to retirement to get the pay-in duration. This is not an exact replication of how pay-in duration is calculated, but gives an idea about the concept used to compute the variable. If assuming that a person works for 40 years and each year makes an equally large contribution in the middle of that year, the pay-in duration would equal:

$$\frac{1}{40} * 39.5 + \cdots + \frac{1}{40} * 0.5 = \frac{1}{40} * (39.5 + \cdots + 0.5) = \frac{800}{40} = 20$$

Average value of buffer fund

The second of the three main variables; the average value of the buffer fund, is calculated in several steps. The value of the buffer fund is given below, for t=2011,…,2020:

$$BF(t) = BF(t-1) + CR(t) - PD(t) + AR(t) - AC(t) \tag{5}$$

where:

$BF(t)$ = value of the buffer fund, end of year t

$BF(t-1)$ = value of the buffer fund, end of year t-1 and beginning of year t

$CR(t)$ = contribution revenue, year t

$PD(t)$ = pension disbursements, year t

$AR(t)$ = absolute return, year t

$AC(t)$ = administration cost, year t

The absolute return in year t is given after the deduction of performance based fees and transaction costs such as commission and the deduction of provision costs, which are fees not based on performance (Swe. ej resultatbaserade avgifter):

$$AR(t) = RD(t) - PC(t) \tag{6}$$

where:

$AR(t)$ = absolute return, year t

$RD(t)$ = absolute return before deduction of provision costs, year t

$PC(t)$ = provision costs, year t

Performance based fees and transaction costs such as commission have however already been deducted from the absolute return before deduction of provision costs.

The value of the buffer fund at the end of each year is then revised twelve times, in a four-step procedure, using the income index. The revised value is then used to get the average value of the buffer fund, for t=2011,…,2020:

$$\overline{BF(t)} = \frac{BF^{rev}(t)+BF^{rev}(t-1)+BF^{rev}(t-2)}{3} \tag{7}$$

where:

$\overline{BF(t)}$ = average value of buffer fund, year t

$BF^{rev}(t)$ = revised value of the buffer fund, at the end of year t

The average value of the buffer fund is the value used to obtain the balance ratio.

Pension Liability

The third of the three main variables; the pension liability, is the sum of the liability to workers and the liability to pensioners:

$$LT(t) = LW(t) + LP(t) \tag{8}$$

where:

$LT(t)$ = total liability, year t

$LW(t)$ = liability to workers, year t

$LP(t)$ = liability to pensioners, year t

The value of the liability to workers is the sum of the pension balance (Swe. pensionsbehållning) for each individual working. The value of the liability to pensioners is the annual pension amount for each age group multiplied by the economic annuity divisor (Swe. ekonomiskt delningstal) for the same age group.

The full model, equation (1)-(8), is used to perform multiple simulations. Starting from the historical data and projections provided by the Swedish Pensions Agency, additional changes to the variables are made in each year. This is not to state that the assumptions made by the Pensions Agency are not correct, but only to test how additional changes affect the balance ratio.

If continuing to break down the variables in the model it would lead to demographic figures of amount of people in a certain age group. As the model is structured in this way, there are no variables in the model representing legal retirement age, number of total pensioners etc. Hence, to perform the simulations, assumptions regarding which variables in the model that are affected by a certain change in a factor, have been made.

When performing the simulations, changes in variables related to demographic and financial factors are tested to see the effect on the balance ratio each year during the period 2011-2020. In the demographic part of the analysis four scenarios are tested including changes in the; number of pensioners, longevity, immigration and birth rate. In each scenario a number of variables in the model are affected. Two potential policy changes; change in retirement age and level of payments in and out of the system, are thereafter tested to see to which extent these counteract the potential demographic changes.

In the financial part of the analysis changes to four different aspects of the buffer fund are considered; return, cost, size of capital and asset allocation. The first three aspects are assessed using simulations of the above model, equation (1)-(8). To see how the asset allocation affects the return-to-risk relationship we look at 20 different assets, from five different asset classes. Monthly returns and standard deviations are computed for each asset. These are then annualised. Four portfolios are constructed using the different assets. Portfolio 1 represents the asset allocation of the buffer fund as it approximately is today, Portfolio 2 is an equal-weighted portfolio, Portfolio 3 is the optimal portfolio, with the highest possible Sharpe ratio given the assets available and Portfolio 4 is the least optimal portfolio, with the lowest possible Sharpe ratio given the assets available. When finding the optimal and the least optimal portfolios (using Excel Solver), two of the investment rules of the buffer fund; maximum exposure to currency risk of 40% and minimum allocation in low-risk assets of 30% are used as restrictions. The portfolios are then compared using their expected returns, standard deviations and Sharpe ratios:

$$SR(portfolio_i) = ER(portfolio_i)/SD(portfolio_i) \tag{9}$$

To better understand the effect of downturns in the economy, causing periods of low or negative return, a risk analysis is then performed using Portfolio 1. The purpose is to show what risk level is imposed by the choice of portfolio, which we believe is not clear in the modelling of the Swedish pension system. In the first period the portfolio, with an initial value of 100, experiences a sharp decline and in the second period an increase. The assumed values for the decline and the increase are -44.6% and 29.6% respectively, which are taken from what the AP3 experienced in 2008 and 2009, as stated by AP3 (2011a). While this is only an example it provides the opportunity to study a possible scenario of downturn. We then model the return during the following eight years, using the expected return and standard deviation of the constructed portfolio. The value at the end of the tenth year is registered for each of the 10 000 simulations, to see the spread in values.

Finally, we simulate the effect of the asset allocation on the balance ratio. The returns of Portfolio 1-3 are modelled using their respective expected return and standard deviation, multiplied with the value of the buffer fund in the beginning of each year. We replace the variable; absolute return before deduction of provision costs, with the absolute return for each of the three portfolios and simulate the value of the balance ratio, for each year during the period 2011-2020. This is performed 10 000 times for each portfolio, recording if the balance ratio is larger than or equal to 1.00. The percentage chance of this occurring in each year is noted for the three portfolios respectively.

V. Data

The data used in the simulations was provided by the Swedish Pensions Agency. Both yearly historical data and yearly projections are given in nominal terms and are used to estimate the balance ratio in the years t=2011,…,2020. As the computation of the value of the buffer fund, the revision of the value of the buffer fund and the computation of the turnover duration requires data from years before year t, data used is from the years 2007-2020. Regarding the data for the period 2016-2020, the Swedish Pensions Agency has stated that the projections are not as certain as those for the period 2011-2015. The variables used as input data can be found in Table 3. A description of each variable can be found in Appendix A. To see how each variable is used in the modelling of the pension system, refer to section IV. Methodology.

Table 3 - Input Data

Variables provided by the Swedish Pensions Agency that is used as input data in the simulations.

Input data
Contribution asset (sv. avgiftstillgång)
Adjusted contribution revenue (sv. utjämnad avgiftsinkomst)
Pay-in duration (sv. intjänandetid)
Pay-out duration (sv. utbetalningstid)
Average value of buffer fund
Absolute return
Absolute return before deduction of provision costs
Administration costs
Buffer fund
Contribution revenue (sv. avgiftsinkomst)
Income index
Pension disbursements
Provision costs
Pension liability
Liability to pensioners
Liability to workers

In the analysis of the asset allocation of the buffer fund, fictive portfolios are constructed using 20 assets from 5 different asset classes; shares, government bonds, corporate bonds, currencies and commodities. The intention with the choice of the five asset classes is to obtain portfolios with different return-to-risk relations, which do not react in the same way to fluctuations in the market.

Daily data, up until December 2010, for the assets, is provided by Datastream, except for the OMX Stockholm Metals & Mining Price Index and the OMX Stockholm Paper & Forest Products Price Index, which are provided by OMX. The intention with the choice of data is to obtain assets that could represent global baskets of assets, within each asset class. To get the best possible estimation all historical data that is available on each series in Datastream and in OMX, is used to compute return, standard deviation and Sharpe ratio for each asset. Therefore the base date varies for different series, between 1970 and 1999. Summary statistics of the assets used can be found in Table 4 and a thorough description in Appendix B.

Table 4 - Summary Statistics of Assets

Portfolios are constructed using assets from five different assets classes; shares, government bonds, corporate bonds, currencies and commodities. To get the best possible estimation, all historical data available on each series, is used. The base dates hence vary for each series. The data ranges from between 1970-1999 to 2010. For each of the 20 assets yearly expected return, yearly standard deviation and the Sharpe ratio are provided.

Asset	Expected return	Standard deviation	Sharpe ratio
MSCI All Country World Price Index	0.0307	0.1103	0.2788
FTSE Global Government US 1-3 years	0.0007	0.0083	0.0812
FTSE Global Government US 7-10 years	0.0057	0.0364	0.1574
FTSE Global Government Euro-zone 1-3 years	-0.0026	0.0079	-0.3363
FTSE Global Government Euro-zone 7-10 years	0.0024	0.0260	0.0928
Dow Jones Corporate 2-year index	0.0005	0.0160	0.0333
Dow Jones Corporate 10-year index	0.0041	0.0393	0.1040
FTSE Euro Corporate (ex.Banks) 1-3 years	-0.0015	0.0075	-0.1974
FTSE Euro Corporate (ex.Banks) 7-10 years	0.0030	0.0205	0.1466
MSCI EAFE Currency Index	0.0192	0.0526	0.3652
S&P/TSX Global Gold Index	0.0272	0.2047	0.1330
S&P GSCI All Wheat Spot	0.0417	0.2607	0.1600
Crude Brent Oil Price	0.0398	0.2837	0.1403
OMXS 30 Index	0.0641	0.1840	0.3487
FTSE Global Government Sweden 1-3 years	-0.0033	0.0080	-0.4132
FTSE Global Government Sweden 7-10 years	0.0035	0.0270	0.1282
Sweden Krona Index	0.0046	0.0402	0.1151
Electricity Sweden Month Average	0.0329	0.6071	0.0541
OMX Stockholm Metals & Mining Price Index	0.0352	0.1806	0.1947
OMX Stockholm Paper & Forest Products Price Index	0.0194	0.1423	0.1361

VI. Empirical Findings

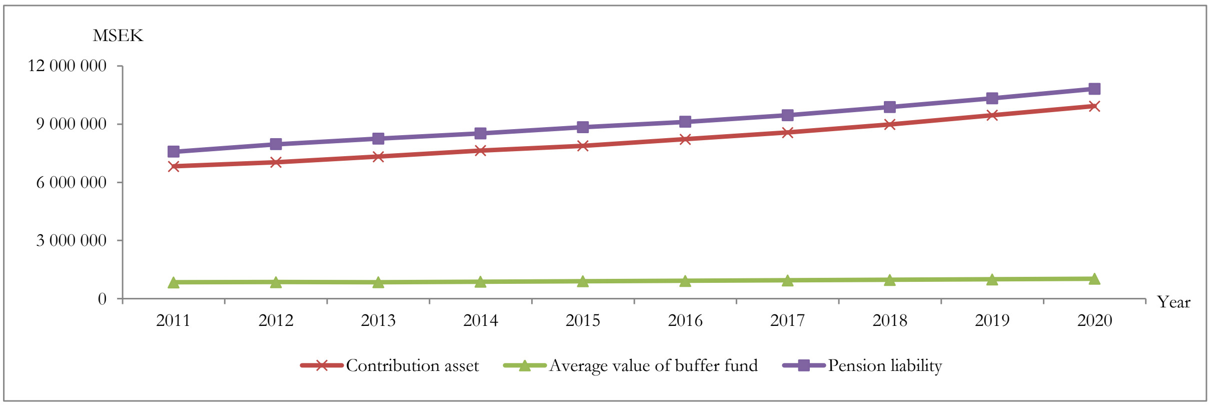
To investigate the effect of changes in demographic and financial factors we perform simulations. First, we perform an initial test with the three main variables; contribution asset, average value of buffer fund and pension liability. Subsequently, we look at four demographic scenarios with changes in the; number of pensioners, longevity, immigration and birth rate. Two potential policy changes; retirement age and level of payments in and out of the system, are thereafter tested to see if they can counteract the effects of increases in the number of pensioners and expected longevity on the balance ratio. In the financial part of the analysis we look at four different aspects of the buffer fund with changes in the; return, cost, size and asset allocation of the buffer fund.

A. Initial Tests of the Balance Ratio

No matter demographic or financial stress on the pension system, it is designed to be stable (The Swedish Pensions Agency, 2010). Our purpose is to analyse within what frames the system is stable. We start out by looking at the three main variables in the pension system; contribution asset, average value of buffer fund and pension liability. Predictions of the variables have been made by the Swedish Pensions Agency. The expected development of the contribution asset, the average value of the buffer fund and the pension liability can be seen in Figure 1.

Figure 1 - Development of the Main Variables

The development, projected by the Swedish Pensions Agency, of the three main variables making up the balance ratio; the contribution asset, average value of buffer fund and pension liability, is given in MSEK, for the period 2011-2020. Regarding the data for the period 2016-2020, the Swedish Pensions Agency has stated that the projections are not as certain as those for the period 2011-2015.



Source: The Swedish Pensions Agency, 2011

To verify that the model is used correctly, we first estimate the balance ratio without any changes in the variables. The results are shown in Table 5 and as can be seen the balance ratios labelled Balance ratio and Est. balance ratio are the same.

We then move on to investigate the sensitivity of the assumptions made regarding each variable, using simulations of equation (1). Positive and negative changes of 1% and 5% are applied to each variable, one at a time. Given the deviations in each year, from the development suggested by the Swedish Pensions Agency, new values of the balance ratio are estimated. The result is presented in Table 5 and Table 6. Neither the fact that the average value of the buffer fund at time t is determined by the value of the buffer fund at time t-1, as seen in equation (5), nor the activation of the automatic balancing mechanism when the balance ratio falls below 1.00 are taken into account in the simulations.

Looking at effects of changes in the contribution asset we find that an increase (decrease) in the contribution asset leads to an increase (decrease) in the balance ratio. For both a 1% and 5% increase the balance ratio ends up above 1.00 in all years. For a 1% decrease the balance ratio ends up below 1.00 in 7 out of 10 years and for a 5% decrease the balance ratio falls below 1.00 in all years.

Regarding the average value of the buffer fund, an increase (decrease) in the average value of the buffer fund leads to an increase (decrease) in the balance ratio. However, the effects on the balance ratio are not as large as for the contribution asset. Looking at Table 4, the balance ratio is above 1.00 in 7 out of 10 years, given an increase of 1%. This is the same amount of years as when no changes to the variables are made. Given a decrease of 1%, the balance ratio is below 1.00 in 4 out of 10 years. Looking instead at Table 6 the effects are larger. With an increase of 5%, the balance ratio stays below 1.00 in 3 out of 7 years. Hence, the positive effect of an increased average value of the buffer fund was not enough to avoid falling below 1.00 in those years. Given a decrease of 5% on the other hand, the balance ratio now falls below 1.00 in 5 out of 10 years. This is two additional years compared to the scenario with no changes to either of the variables.

The changes in the pension liability have the largest effect on the balance ratio. For a 5% increase and decrease respectively the balance ratio takes on the lowest and highest values observed throughout the initial test. An increase (decrease) in the pension liability has a negative (positive) effect on the balance ratio. With an increase of 1% the balance ratio falls below 1.00 in 7 out of 10 years and with an increase of 5% the balance ratio falls below 1.00 in all 10 years. For a decrease of both 1% and 5%, the balance ratio is above 1.00 in all 10 years.

Large parts of these variables are connected to the demographic development in the country. In this initial test it is visible what an important impact small changes have on the balance ratio. The continued analysis will focus on the understanding of how demographic and financial factors affect the balance ratio.

Table 5 - The Balance Ratio and Changes in the Main Variables of 1%

To simulate the effect on the balance ratio (BR) given changes in the contribution asset (CA), the average value of the buffer fund ($\overline{BF}$) and the pension liability (LT), the following equation is used, for t=2011,…,2020:

$$BR(t) = \frac{\text{CA(t)} + \overline{\text{BF(t)}}}{\text{LT(t)}}$$

Positive and negative changes of 1% are applied to each one of the three variables. The balance ratio in therefore estimated for the years 2011-2020.

Year	Balance ratio	Est balance ratio	Contribution asset		Avg. buffer fund		Pension liability	
			1%	-1%	1%	-1%	1%	-1%
2011	1.0132	1.0132	1.0222	1.0042	1.0143	1.0121	1.0032	1.0235
2012	0.9917	0.9917	1.0005	0.9828	0.9928	0.9906	0.9819	1.0017
2013	0.9921	0.9921	1.0010	0.9832	0.9931	0.9911	0.9823	1.0021
2014	1.0003	1.0003	1.0093	0.9913	1.0013	0.9993	0.9904	1.0104
2015	0.9939	0.9939	1.0028	0.9850	0.9949	0.9929	0.9841	1.0039
2016	1.0039	1.0039	1.0129	0.9949	1.0049	1.0029	0.9940	1.0140
2017	1.0072	1.0072	1.0163	0.9981	1.0082	1.0062	0.9972	1.0174
2018	1.0083	1.0083	1.0173	0.9992	1.0092	1.0073	0.9983	1.0184
2019	1.0132	1.0132	1.0223	1.0040	1.0142	1.0122	1.0032	1.0234
2020	1.0133	1.0133	1.0225	1.0042	1.0143	1.0124	1.0033	1.0236

Table 6 - The Balance Ratio and Changes in the Main Variables of 5%

To simulate the effect on the balance ratio (BR) given changes in the contribution asset (CA), the average value of the buffer fund ($\overline{BF}$) and the pension liability (LT), the following equation is used, for t=2011,…,2020:

$$BR(t) = \frac{\text{CA(t)} + \overline{\text{BF(t)}}}{\text{LT(t)}}$$

Positive and negative changes of 5% are applied to each one of the three variables. The balance ratio in therefore estimated for the years 2011-2020.

Year	Balance ratio	Est balance ratio	Contribution asset		Avg. buffer fund		Pension liability	
			5%	-5%	5%	-5%	5%	-5%
2011	1.0132	1.0132	1.0583	0.9682	1.0188	1.0076	0.9650	1.0665
2012	0.9917	0.9917	1.0358	0.9475	0.9971	0.9863	0.9445	1.0439
2013	0.9921	0.9921	1.0365	0.9477	0.9973	0.9869	0.9449	1.0443
2014	1.0003	1.0003	1.0451	0.9555	1.0055	0.9951	0.9527	1.0530
2015	0.9939	0.9939	1.0385	0.9493	0.9990	0.9888	0.9466	1.0462
2016	1.0039	1.0039	1.0490	0.9588	1.0090	0.9988	0.9561	1.0567
2017	1.0072	1.0072	1.0525	0.9618	1.0122	1.0022	0.9592	1.0602
2018	1.0083	1.0083	1.0537	0.9628	1.0132	1.0033	0.9602	1.0613
2019	1.0132	1.0132	1.0590	0.9674	1.0181	1.0083	0.9649	1.0665
2020	1.0133	1.0133	1.0592	0.9674	1.0181	1.0086	0.9651	1.0667

B. Changes in Demographic Factors

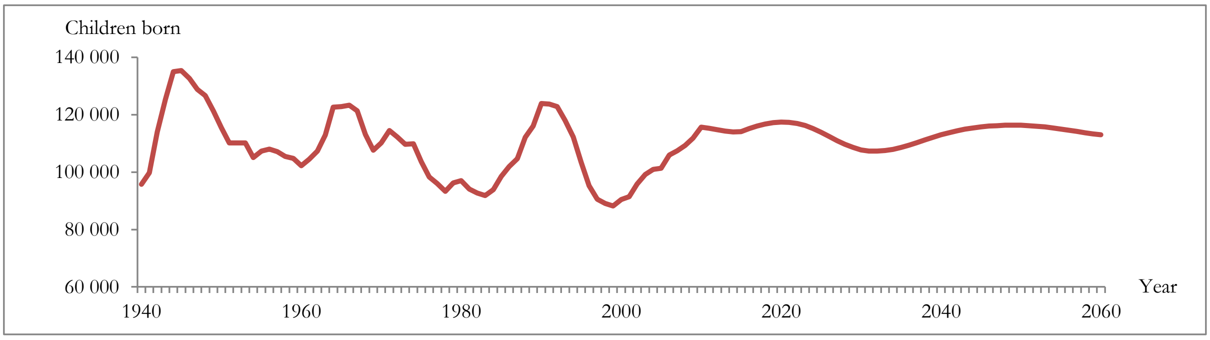
The effects that changes in different demographic factors have on the balance ratio are investigated further in this part of the analysis. We look at the effect changes in the; number of pensioners, longevity, immigration and birth rate, have on the balance ratio.

The Effect on the Balance Ratio from Changes in the Number of Pensioners

The Swedish Pensions Agency, among others, has stated that the large year cohorts of the 1940's becoming pensioners, puts pressure on the balance ratio (The Swedish Pensions Agency, 2011a). To get perspective on how severe this issue is, we look at the effect on the balance ratio, given increases and decreases in the number of pensioners. We assume that there is no change in the number of workers. Hence, we study an isolated increase in the number of pensioners, not a shift in the age structure of the population where there are more pensioners and fewer workers.

Figure 2 - Birth Rate in Sweden 1940-2060

Historical data and projections for the birth rate in Sweden during the period 1940-2060.



Source: SCB, 2011

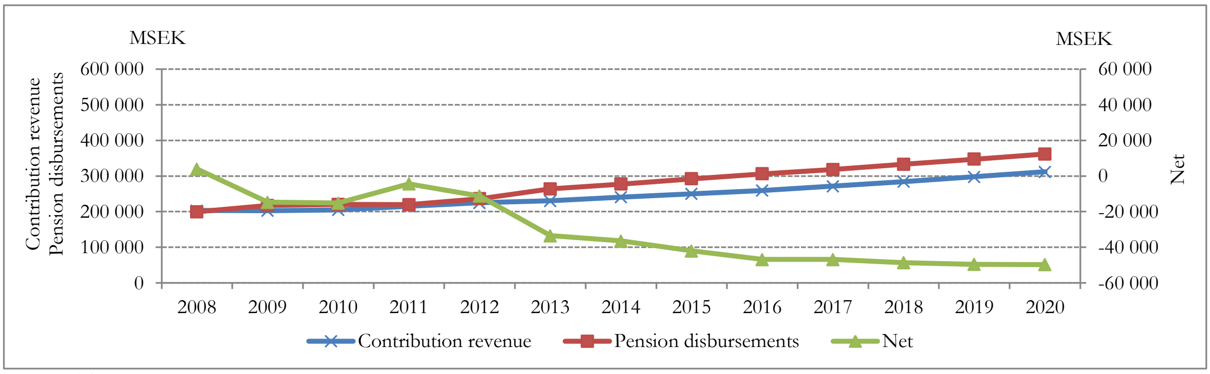
To see which potential effect a change in the number of pensioners has on the balance ratio, we look at each one of the three main variables; contribution asset, average value of buffer fund and pension liability, separately.

Regarding the contribution asset, the turnover duration does not change since the pensioners are still expected to live as long and the pension disbursements for each pensioner are thus being paid out over the same number of years.

Looking at the average value of the buffer fund, we find that there will be a change in the pension disbursements. Given an increase in the number of pensioners, pension disbursements will increase since there are more pensioners to pay out pension to. Because of that, the net of contribution revenue and pension disbursements decrease. A decrease in the net is the prevailing trend, which can be seen in Figure 3. If the net is negative, it leads to a decrease in the buffer fund, since it has to support the system deficit.

Figure 3 - Trend in Contribution Revenue and Pension Disbursements

The contribution revenue, pension disbursements and the net are displayed in MSEK, during the years 2008-2020.



Source: The Swedish Pensions Agency, 2011

The pension liability is affected through liability to pensioners, which increase since there are more pensioners in the system. As stated earlier, the value of the liability to pensioners is the annual pension amount for each age group multiplied by the economic annuity divisor. Therefore, if pension disbursements increase, the liability to pensioners increases as well.

In the simulations a change in the number of pensioners is hence assumed to affect the balance ratio through changes in the variables; pension disbursements and liability to pensioners. We simulate changes of 1% and 5% in the number of pensioners to see the effect on the balance ratio in the years 2011-2020. Given an increase in pensioners of 5%, pension disbursements and liability to pensioners are assumed to increase with 5% respectively. The results can be found in Table 7.

Table 7 - Number of Pensioners

A change in the number of pensioners (NP) effects the balance ratio through changes in the variables; pensions disbursements (PD) and liability to pensioners (LP). Simulations are performed with changes of 1% and 5% in the number of pensioners and the balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ	**Δ NP**	**-5%**	**-1%**	**1%**	**5%**
		→ Δ PD	-5%	-1%	1%	5%
		→ Δ LP	-5%	-1%	1%	5%
2011	1.0132		1.0363	1.0178	1.0087	0.9909
2012	0.9917		1.0160	0.9965	0.9869	0.9681
2013	0.9921		1.0183	0.9973	0.9870	0.9669
2014	1.0003		1.0281	1.0058	0.9949	0.9735
2015	0.9939		1.0230	0.9996	0.9882	0.9658
2016	1.0039		1.0348	1.0100	0.9978	0.9741
2017	1.0072		1.0393	1.0135	1.0009	0.9762
2018	1.0083		1.0416	1.0148	1.0017	0.9761
2019	1.0132		1.0477	1.0200	1.0064	0.9799
2020	1.0133		1.0489	1.0203	1.0064	0.9791

We find that a decrease (increase) in the number of pensioners has a positive (negative) effect on the balance ratio. However, the debate today is not about a decrease but an increase in the number of pensioners due to the large number of people born in the 1940's, see Figure 2.

A 1% increase in the number of pensioners has a negative effect on the balance ratio and in 5 out of 10 years the balance ratio is 1.00. In the scenario without any changes to the variables the balance ratio is below 1.00 in only 3 out of 10 years. There is a big difference with a 5% increase, where the balance ratio falls below 1.00 in all the years. Given a decrease of 1% the balance ratio is below 1.00 during the same amount of years, as when there was no change. For a 5% decrease however the balance ratio is above 1.00 in all 10 years.

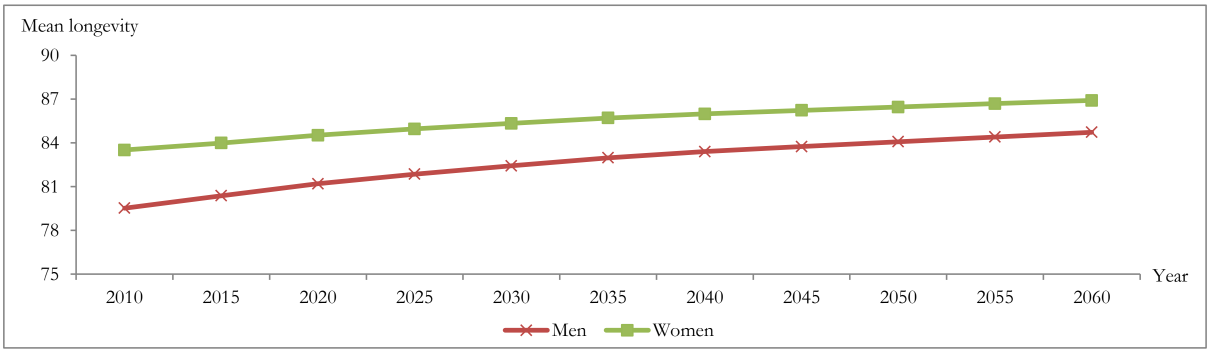
The number of pensioners thus has an important effect on the balance ratio and will be set in context with other variables later in the analysis. While the number of workers remains unchanged in this analysis, the number of pensioners in relation to the number of workers is of importance, since the pension system is a PAYG system. Workers pay contributions to the system, which are paid out to pensioners as pension disbursements. Ageing in the population is not in itself something that can be controlled, however as retirement age can be set differently through policies, the number of pensioners can be controlled to some extent. Potential policies will be discussed further in section "Policy changes".

The Effect on the Balance Ratio from Changes in Longevity

Another issue regarding the pension system is that people are expected to live longer in the future. As can be seen in Figure 4, women are expected to live longer than men, but longevity is expected to increase in both groups. In 2060 the average woman is expected to live until approximately the age of 86.9 and the average man to approximately the age of 84.7 (SCB, 2011).

Figure 4 - Expected Longevity in Sweden

Expected mean longevity for men and women in Sweden for the period 2010-2050. The projections are as of 2011-04-15.



Source: SCB, 2011

In the analysis of longevity, we assume that the number of pensioners will increase as a consequence of the increase in longevity. It is also assumed that the retirement age is kept constant. The analysis is divided into two parts; expected increase in longevity and unexpected increase in longevity. The reason is that when an increase in longevity is expected the pension disbursements will be lowered and paid out over a longer period of time, while the pension disbursements to each pensioner will remain unchanged if the increase in longevity is unexpected.

To see which potential effects an increase in longevity has on the balance ratio, we look at each one of the three main variables; contribution asset, average value of buffer fund and pension liability, separately.

The contribution asset will be affected as the pay-out duration will increase. This leads to a higher turnover duration, which means that the money will be in the system longer. Both in the case of expected and unexpected increase in longevity, pension disbursements have to be paid out over more years. However, it is important to notice that while both an expected and unexpected increase leads to pension disbursements being paid out over a longer period, only an unexpected increase leads to too much money being paid out from the system, eroding the buffer fund.

Looking at the buffer fund the annual disbursements do not change in case of an expected increase in longevity. While the number of pensioners increase, this is offset by the fact that the size of the annual pension disbursements to each pensioner decrease, as life-length increases. However, if there is an unexpected increase in longevity, the size of the annual pension disbursements to each person remains unchanged and the number of pensioners increases, leading to an increase the total annual pension disbursements.

The pension liability is affected through the liability to pensioners. In the case of the expected increase in longevity there is an increase in the liability to pensioners since the number of pensioners increase. Given that the increase in longevity is unexpected, the liability to pensioners will increase, as the pension disbursements increase. A problem if the increase in longevity is unexpected is that the annuity devisor does not change after 65 years of age and hence becomes a risk factor in the system (The Swedish Pensions Agency, 2011a). Thus, expectations about longevity are important when determining the effect on the balance ratio.

In the simulations a change in the longevity is hence assumed to affect the balance ratio through changes in the variables; pay-out duration and liability to pensioners in the expected case and pay-out duration, pension disbursements and liability to pensioners in the unexpected case. We simulate changes of 1% and 5% in the longevity to see the effect on the balance ratio in the years 2011-2020.

Assuming that the average person is a pensioner between the age of 63 and 83, a 5% (1%) increase in longevity would mean a 20.75% (4.15%) increase in the pay-out time, since pension disbursements will be paid out for 24.15 (20.83) years instead of 20. This is the case both when the increase is expected and unexpected.

Annual pension disbursements will remain unchanged in the unexpected case, which can be illustrated in a simplified example where the pension disbursements are given by, the pension disbursements to each person multiplied by the number of pensioners. We assume that a person has earned a pension credit (Swe. pensionsrätt) of 100, which is disbursed over 20 years. Assuming that different age groups of pensioners are equally large, the number of pensioners will increase as much as the time spent as a pensioner. With an increase in longevity, the pension disbursements are being paid out over a longer period of time and the number of pensioners has increased. The annual disbursements decreases as longevity increase. At the same time the number of pensioners increase, which means that the total effect is unchanged: $\frac{100}{24.15} * \frac{24.15}{20} * NP$, where NP is the number of pensioners. In the unexpected increase of 5% (1%) the pension disbursements will instead increase: $\frac{100}{20} * \frac{24.15}{20} * NP$, where NP is the number of pensioners, with 20.75% (4.15%).

The liability to pensioners will increase with 20.75% (4.15%) if there is a 5% (1%) expected increase in longevity since the number of pensioners will increase with 20.75% (4.15%). If there is a 5% (1%) unexpected increase in longevity, liability to pensioners will increase by 20.75% (4.15%) as the pension disbursements increase with 20.75% (4.15%). Since the change is unexpected it is not known that there has been an increase in longevity and hence an increase in the number of pensioners.

The results from the simulations can be found in Table 8. An increase (decrease) in longevity has a negative (positive) effect on the balance ratio in both the expected and unexpected case. We find that the effects are larger in the unexpected case.

For a 1% expected increase in longevity the balance ratio is below 1.00 in 4 out of 10 years. If the increase is unexpected the balance ratio is below 1.00 in all years but 2011. This can be compared to 3 out of 10 years when no change is made. Given a 5% increase, the balance ratio is below 1.00 in 7 out of 10 years if expected and 10 out 10 years if unexpected. A 5% decrease in longevity leads to the balance ratio being below 1.00 in all years, both if expected and unexpected. For a 1% decrease the balance ratio is below 1.00 during 3 years if expected and during 1 year in the unexpected.

Table 8 - Longevity

A change in the longevity (L) effects the balance ratio through changes in the variables; pay-out duration (OD) and liability to pensioners (LP) in the expected case and pay-out duration (OD), pension disbursements (PD) and liability to pensioners (LP) in the unexpected case. Simulations are performed with changes of 1% and 5% in the longevity and the balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ		Expected				Unexpected			
		Δ L	-5%	-1%	1%	5%	-5%	-1%	1%	5%
		→ Δ OD	-20.75%	-4.15%	4.15%	20.75%	-20.75%	-4.15%	4.15%	20.75%
		→ Δ PD					-20.75%	-4.15%	4.15%	20.75%
		→ Δ LP	-20.75%	-4.15%	4.15%	20.75%	-20.75%	-4.15%	4.15%	20.75%
2011	1.0132		1.0216	1.0148	1.0117	1.0059	1.0459	1.0194	1.0072	0.9849
2012	0.9917		1.0009	0.9934	0.9900	0.9837	1.0303	0.9990	0.9846	0.9583
2013	0.9921		1.0037	0.9943	0.9900	0.9822	1.0387	1.0008	0.9836	0.9520
2014	1.0003		1.0118	1.0025	0.9982	0.9901	1.0525	1.0101	0.9908	0.9551
2015	0.9939		1.0057	0.9962	0.9917	0.9836	1.0521	1.0049	0.9833	0.9438
2016	1.0039		1.0171	1.0063	1.0015	0.9928	1.0693	1.0161	0.9920	0.9480
2017	1.0072		1.0195	1.0095	1.0049	0.9966	1.0771	1.0203	0.9945	0.9473
2018	1.0083		1.0206	1.0106	1.0060	0.9977	1.0830	1.0223	0.9947	0.9442
2019	1.0132		1.0255	1.0155	1.0110	1.0027	1.0925	1.0280	0.9988	0.9453
2020	1.0133		1.0254	1.0156	1.0111	1.0030	1.0966	1.0289	0.9982	0.9421

The values of the balance ratio given a decrease in expected longevity are lower than with a decrease in the number of pensioners of the same size. The values for unexpected are however higher than for the same decrease in the number of pensioners. For an increase in each of the factors, the values of the balance ratio are highest for expected longevity, followed by the number of pensioners and then unexpected longevity. The severity of an increase is hence largest for an unexpected increase in longevity. However, it is more interesting to look at the expected analysis since it is realistic to assume that the increase in longevity is expected, given the availability of population projections.

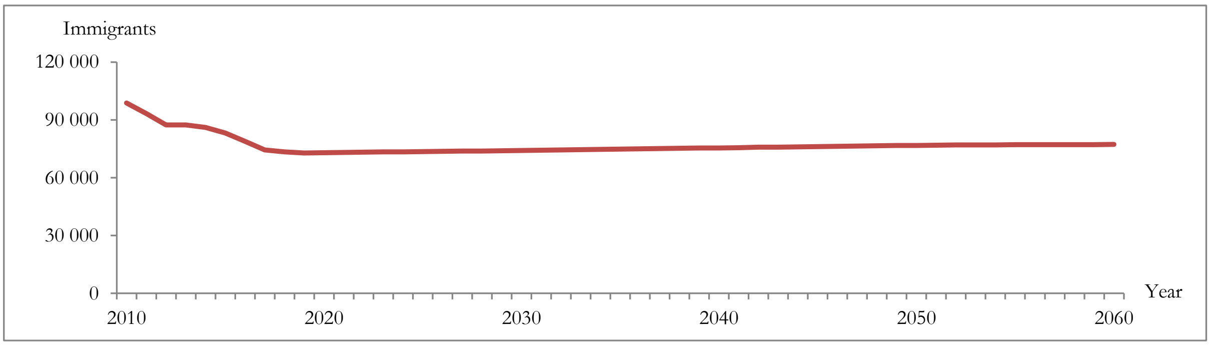
A 1% increase in expected longevity corresponds to an expected age of death of 83.83 years (according to the simplified example), which according to the projections by SCB would be the case in approximately 2030, if it is assumed that there are equally many women and men in Sweden. A 5% increase in expected longevity, corresponding to an expected age of death of 87.15 years (according to the simplified example), has a negative effect on the balance ratio but according to the projections of SCB this will not be the case in the foreseeable future.

The Effect on the Balance Ratio from Changes in the Immigration

The key in a PAYG system is that the people who are working support the pensioners, with the buffer fund functioning as a reserve to counteract minor fluctuations. Therefore it is very important that there are enough people working. One factor which can increase the number of workers is immigration. As can be seen in Figure 5 the immigration will decrease in the near future and after that it will stabilise, with a slightly upward-sloping trend. One cannot say if the majority of immigrants are children, people in working age or pensioners. The analysis is performed considering changes in the number of immigrants that start working, not the total number of immigrants coming to Sweden.

Figure 5 - Number of Immigrants in Sweden

Expected total number of immigrants coming to Sweden during the period 2010-2060.



Source: SCB, 2011

To see which potential effects an increase in immigration has on the balance ratio, we look at each one of the three main variables; contribution asset, average value of buffer fund and pension liability, separately.

The contribution asset will be affected since there will be an increase in the adjusted contribution revenue, as more people work. There is also an increase in the contribution revenue, since there are more people working, affecting the average value of the buffer fund. Liability to workers will increase as there are more workers earning pension credit (Swe. pensionsrätt) each year.

In the simulations a change in immigration is hence assumed to effect the balance ratio through changes in the variables; adjusted contribution revenue, contribution revenue and liability to workers. We simulate changes of 1% and 5% in the number of workers, caused by an increased immigration, to see the effect on the balance ratio in the years 2011-2020.

If the increase in the number of workers, caused by the increase in the number of immigrants, is 5% the adjusted contribution revenue, the contribution revenue and the liability to workers will increase with 5% respectively.

As can be seen in Table 9 an increase (decrease) in immigration, which adds to number of workers, has a positive (negative) effect on the balance ratio. For a 5% increase (decrease), the balance ratio is above 1.00 in all (none) of the years. Given a 1% increase the balance ratio is above 1.00 in 7 out of 10 years, which is the same amount of years as when there is no change. For a 1% decrease the balance ratio is below 1.00 in 5 out of 10 years.

People in working age and the proportion of them that are employed determine the number of people paying contributions to the system. In the short term, size of net immigration is the factor that has the largest effect on the number of people in working age. In the long term the birth rate has the largest effect (The Swedish Pensions Agency, 2011a).

Table 9 - Number of Immigrants

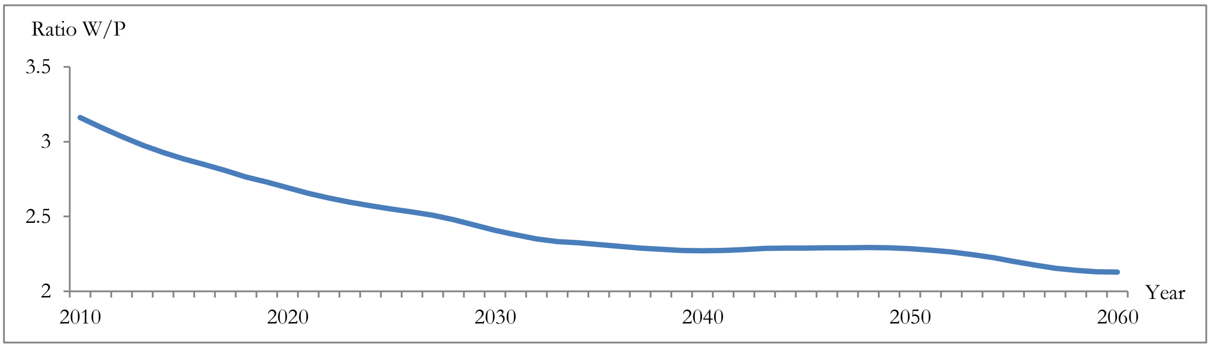
A change in the number of workers (NW), caused by a change in immigration, effects the balance ratio through changes in the variables; adjusted contribution revenue (ACR), contribution revenue (CR) and liability to workers (LW). Simulations are performed with changes of 1% and 5% in the number of workers and the balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ	Δ NW	-5%	-1%	1%	5%
		→ Δ ACR	-5%	-1%	1%	5%
		→ Δ CR	-5%	-1%	1%	5%
		→ Δ LW	-5%	-1%	1%	5%
2011	1.0132		0.9956	1.0098	1.0166	1.0297
2012	0.9917		0.9727	0.9880	0.9953	1.0094
2013	0.9921		0.9712	0.9880	0.9961	1.0117
2014	1.0003		0.9779	0.9959	1.0046	1.0214
2015	0.9939		0.9703	0.9893	0.9984	1.0161
2016	1.0039		0.9786	0.9990	1.0088	1.0276
2017	1.0072		0.9809	1.0021	1.0123	1.0319
2018	1.0083		0.9808	1.0029	1.0135	1.0340
2019	1.0132		0.9847	1.0076	1.0187	1.0400
2020	1.0133		0.9839	1.0076	1.0190	1.0410

The population in total can also increase due to the fact that the number of pensioners increase and that people live longer, even though the group of workers do not increase. As can be seen in Figure 6 the case in Sweden is that, the ratio worker-to-pensioner is expected to decrease, which has a negative effect on the pension system.

Figure 6 - Ratio of Workers-to-Pensioner

Expected number of people between 20-64 years old divided by the expected number of people above 65 years old in Sweden. The workers-to-pensioner ratio (W/P) is given for the period 2010-2060.



Source: SCB, 2011

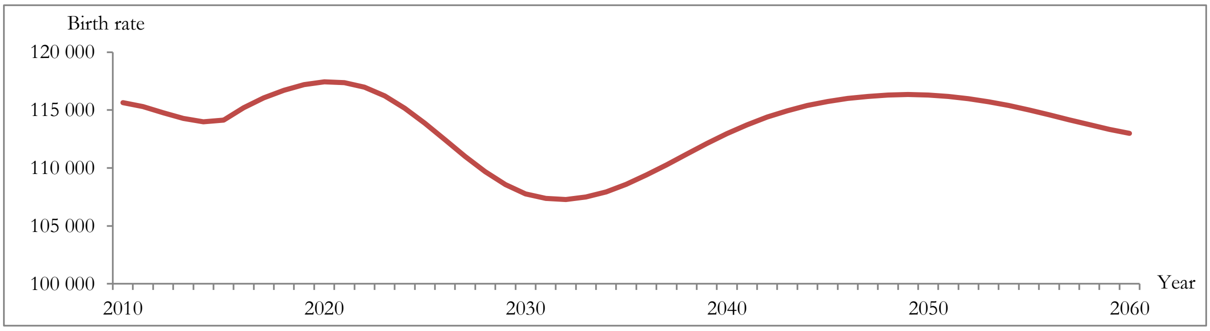
The increase in immigration, seen in Figure 5, is not enough to make the ratio worker-to-pensioner increase, see Figure 6. The birth rate has been stated to have the largest long term effect on the number of people in working age, which will be analysed in the next section.

The Effect on the Balance Ratio from Changes in the Birth Rate

As the birth rate is said to have the largest long term effect on the balance ratio, it is interesting to look at the projections of the future and analyse the effect of changes in the birth rate on the balance ratio. As can be seen in Figure 7, the birth rate is expected to fluctuate a lot in the future. However, the birth rate have fluctuated a lot more in the past, which is shown in Figure 2. In addition, the birth cohorts of the 1940's, have been the largest in the past and seems to be the largest when looking at the foreseeable future.

Figure 7 - Birth Rate in Sweden 2010-2060

Projection of birth rate in Sweden for the period 2010-2060.



Source: SCB, 2011

Given that there is a spike in birth rates in the next coming years, that change will not have effect until 20-25 years from now, when those people start working. If we assume that there was a baby boom 20-25 years ago, we can simulate the effects on the system today. Since it will increase the number of workers it will have the same effect on the balance ratio as immigration, see result in section "Immigration".

A delayed effect, as seen today, is that higher birth rate during some years, followed by years of lower birth rate put pressure on the balance ratio, as the number of pensioners increase. There is hence a continuous process in the system where liability increases relative to assets and after a while assets are increasing relative to the liability. Though, when such demographic changes take extreme values it has large effects on the balance ratio and thus need to be considered before the strain gets too hard on the system. In the next section policy changes are considered as a way to counteract some of the negative effects that demographic changes have on the pension system.

C. Policy Changes

Large effects from changes in demographic factors have been discovered in the analyses above. It is therefore interesting to look at potential policy changes, which could be used as tools to resist and counteract the pressure on the pension system. We will therefore consider two possible policy changes; a raise in retirement age and changes in the level of payments in and out of the system. These will first be considered separately and then in combination with two demographic scenarios; an increase in the number of pensioners and an expected increase in longevity.

Retirement Age

One policy considered is to raise the retirement age in society, as a means to keep pensions on the same level, i.e. that the balance ratio stays above 1.00. The analysis is performed with 1, 2 and 3 years increase in retirement age. We start by looking at the effect on the balance ratio when the policy is implemented. To isolate that effect the analysis is made with the assumptions that the raised retirement age means a shift in the age structure of the population, where more people work and fewer are pensioners but the total number of people stays the same. Thus, the prolonged effect of workers having earned more pension credits (Swe. pensionsrätt) during their years of working, and hence increasing the liability to workers, and pensioners as these workers retire, is not taken into account in the simulations.

To see which potential effects a raised retirement age has on the balance ratio, we look at each one of the three main variables; contribution asset, average value of buffer fund and pension liability, separately.

The contribution asset will be affected as the contribution revenue increases, as there are more age groups working. The pay-in duration will increase as much as the pay-out duration will decrease in absolute terms, leaving the turnover duration unchanged.

Regarding the average value of the buffer fund, the contribution revenue will increase, as there are more age groups working. Pension disbursements will however, remain unchanged. The reason for this is that the number of pensioners decreases at the same time as the annual pension disbursements to each person increases as the amount of pension credit earned by that person will be paid out over fewer years.

The pension liability is affected both by a change in the liability to workers and a change in the liability to pensioners. As the number of workers increase and the number of pensioners decrease, the liability to workers increase and the liability to pensioners decrease.

In the simulations a raise in retirement age is hence assumed to effect the balance ratio through changes in the variables; adjusted contribution revenue, contribution revenue, liability to workers and liability to pensioners. We simulate changes with 1, 2 and 3 years of raised retirement age, to see the effect on the balance ratio in the years 2011-2020.

Assuming that the number of workers are equally spread over the age groups and that each person works for 40 years, raising the retirement age with 2 years will lead to an increase in the adjusted contribution revenue, the contribution revenue and the liability to workers with 5% respectively. If we also assume that the number of pensioners is equally spread along all age groups and each person is a pensioner for 20 years, liability to pensioners will instead decrease with 10%.

As can be seen in Table 10, raising the age of retirement has a positive effect on the balance ratio. Given a raise of 1, 2 or 3 years the balance ratio is above 1.00 in all years.

Table 10 - Retirement Age

A change in the age of retirement (RA), effects the balance ratio through changes in the variables; adjusted contribution revenue (ACR), contribution revenue (CR), liability to workers (LW) and liability to pensioners (LP). Simulations are performed with 1, 2 and 3 years raised retirement age and the balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ	Δ RA	+ 1 year	+ 2 year	+ 3 year
		→ Δ ACR	2.5%	5%	7.5%
		→ Δ CR	2.5%	5%	7.5%
		→ Δ LW	2.5%	5%	7.5%
		→ Δ LP	-5%	-10%	-15%
2011	1.0132		1.0390	1.0649	1.0907
2012	0.9917		1.0182	1.0449	1.0716
2013	0.9921		1.0202	1.0483	1.0766
2014	1.0003		1.0295	1.0588	1.0883
2015	0.9939		1.0237	1.0537	1.0838
2016	1.0039		1.0350	1.0662	1.0977
2017	1.0072		1.0388	1.0705	1.1025
2018	1.0083		1.0405	1.0729	1.1055
2019	1.0132		1.0461	1.0792	1.1125
2020	1.0133		1.0467	1.0803	1.1141

According to Westling Palm & Settergren (2011), it would be negative for the State to increase the age of retirement. It would mostly be the low income earners that would gain from such a change, as the benefits from of early retirement (Swe. förtidspension) increase with a raised retirement age and low income earners are the group using that privilege to the greatest extent. The State would need to pay out more health insurance since people that do not work until retirement often do so because of inability to work. These amounts are also pension-qualifying (Swe. pensionsgrundande belopp), which then has an effect on the pension system. Because of these issues the earliest age of when it is possible to get early retirement would need to be raised as well.

We then move on to look at the combined effect of a raise in retirement age and an increase in the number of pensioners. The assumptions made regarding which variables are affected and to which extent in the previous analyses, are used simultaneously. The variables being adjusted are hence; adjusted contribution revenue, contribution revenue, pension disbursements, liability to workers and liability to pensioners.

The results, found in Table 11, show that the combined effect of a raise in retirement age and an increase in the number of pensioners is positive on the balance ratio. Each year, the value of the balance ratio ends up above the value of the balance ratio when there was no change. Thus, we can conclude that a raise of the retirement age of as little as 1 year can counteract the effects of an increase in the number of pensioners up to 5%. However, with a 5% increase in the number of pensioners and a 1 year raise in the retirement age the balance ratio is still below 1.00 in 3 out of 10 years. For the balance ratio to be above 1.00 in all years, there needs to be a 2 year raise in retirement age.

Table 11 - Retirement Age and Changes in Number of Pensioners

A change in the age of retirement (RA) together with a change in the number of pensioners (NP), effects the balance ratio through changes in the variables; adjusted contribution revenue (ACR), contribution revenue (CR), pension disbursements (PD), liability to workers (LW) and liability to pensioners (LP). Simulations are performed with 1 and 2 years raised retirement age and 1% and 5% increase in the number of pensioners. The balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ	**Δ RA**	**+ 1 year**	**+ 1 year**	**+ 2 years**	**+ 2 years**
		Δ NP	**1%**	**5%**	**1%**	**5%**
		→ Δ ACR	2.5%	2.5%	5%	5%
		→ Δ CR	2.5%	2.5%	5%	5%
		→ Δ PD	1%	5%	1%	5%
		→ Δ LW	2.5%	2.5%	5%	5%
		→ Δ LP	-4%	0%	-9%	-5%
2011	1.0132		1.0344	1.0162	1.0601	1.0416
2012	0.9917		1.0134	0.9942	1.0399	1.0204
2013	0.9921		1.0149	0.9944	1.0430	1.0220
2014	1.0003		1.0239	1.0021	1.0531	1.0308
2015	0.9939		1.0179	0.9950	1.0477	1.0243
2016	1.0039		1.0288	1.0045	1.0599	1.0351
2017	1.0072		1.0323	1.0071	1.0640	1.0382
2018	1.0083		1.0338	1.0077	1.0661	1.0394
2019	1.0132		1.0392	1.0121	1.0722	1.0445
2020	1.0133		1.0396	1.0118	1.0731	1.0447

Finally, we look at the combination of a raise in retirement age and an increase in expected longevity. The assumptions regarding which variables are affected and to which extent are the same as in the two individual analyses of the two changes. The variables being adjusted are hence; adjusted contribution revenue, pay-out duration, contribution revenue, pension disbursements, liability to workers and liability to pensioners. The results from the simulations can be found in Table 12. The total effect, when combining a raise in retirement age with an expected increase in longevity, is positive for the balance ratio. The balance ratio is above 1.00 in all years for each one of the scenarios. The effects are greater than in the previous simulation with increased number of pensioners. The reason for this is that the severity is larger for an increase in the number of pensioners than for an expected increase in longevity of the same size, as stated in earlier analyses.

Table 12 - Retirement Age and Changes in Expected Longevity

A change in the age of retirement (RA) together with a change in the expected longevity (L), effects the balance ratio through changes in the variables; adjusted contribution revenue (ACR), pay-out duration (OD) contribution revenue (CR), liability to workers (LW) and liability to pensioners (LP). Simulations are performed with 1 and 2 years raised retirement age and 1% and 5% increase in the expected longevity. The balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ	Δ RA	+ 1 year	+ 1 year	+ 2 years	+ 2 years
		Δ L	1%	5%	1%	5%
		→ Δ ACR	2.5%	2.5%	5%	5%
		→ Δ OD	4.15%	20.75%	4.15%	20.75%
		→ Δ CR	2.5%	2.5%	5%	5%
		→ Δ LW	2.5%	2.5%	5%	5%
		→ Δ LP	-0.85%	15.75%	-5.85%	10.75%
2011	1.0132		1.0374	1.0315	1.0632	1.0571
2012	0.9917		1.0165	1.0099	1.0431	1.0363
2013	0.9921		1.0180	1.0097	1.0460	1.0374
2014	1.0003		1.0273	1.0187	1.0565	1.0475
2015	0.9939		1.0214	1.0127	1.0512	1.0420
2016	1.0039		1.0325	1.0231	1.0636	1.0536
2017	1.0072		1.0364	1.0275	1.0680	1.0584
2018	1.0083		1.0381	1.0291	1.0703	1.0607
2019	1.0132		1.0437	1.0347	1.0766	1.0670
2020	1.0133		1.0443	1.0355	1.0778	1.0682

Events in European countries show that there is usually great resistance among the citizens against pension reforms, such as raising the retirement age. Though, what is not often brought forward, is that even if the people would work for 1 or 2 more years, their time as pensioners will still increase due to the increase in longevity projected. Other options, if the PAYG system is maintained, could be to pay more to the system while working or get less when retiring, which we will focus on now.

Pay More or Get Less

The cash-flows in and out of the system are determined both by the number of workers/pensioners and the level of payments from/to each person. Since we have looked at changes in the number of workers and pensioners, we will now also look at the level of payments. Hence, the second policy change considered is changes of how much workers pay into the system and how much pensioners get out from the system. We look at 1% and 5% increases of payments coming into the system and 1% and 5% decreases in payments going out of the system.

To see which potential effects changes in the level of payments going in and out of the system have on the balance ratio, we look at each one of the three main variables; contribution asset, average value of buffer fund and pension liability, separately. We start by looking at what happens if the level of payments into the system increase and then we look at what happens when there is a decrease in payments going out of the system.

As the level of payments coming into the system increases, the contribution asset is affected by the resulting increase in the adjusted contribution revenue. The contribution revenue increases simultaneously, affecting the average value of the buffer fund. The pension liability is affected as the liability to workers increase, as a consequence of the increased contributions.

As the level of payments going out of the system decreases, the contribution assets remains unchanged. The pension disbursements decrease, affecting the average value of the buffer fund. The fact that there is a decrease in pension disbursements in turn lead to a decrease in the liability to pensioners, which affects the total pension liability.

In the simulations a change in the level of payments is hence assumed to effect the balance ratio through changes in the variables; adjusted contribution revenue, contribution revenue and liability to workers if the level of payments coming in to the system changes and pension disbursements and liability to pensioners if the level of payments going out of the system changes. We simulate 1% and 5% increases in the level of payments into the system and 1% and 5% decreases to the level of payments out of the system, to see the effect on the balance ratio in the years 2011-2020.

If the workers pay 5% more into the system the adjusted contribution revenue, the contribution revenue and the liability to workers increase with 5% respectively. If the pensioners get 5% less from the system the pension disbursements and the liability to pensioners decrease with 5% respectively.

As can be seen in Table 13, both an increase in payments to the system and a decrease in payments out of the system have positive effects on the balance ratio. When changes of 5% are made the balance ratio is above 1.00 in all years. However, with changes of 1% the balance ratio remains below 1.00 in 3 out of 10 years even though there are increases in the values of the balance ratios, compared to when no changes are made.

Getting less has a larger effect on the balance ratio than paying more. The fact that getting less has a larger effect is in line with the results in the initial test, where changes to the pension liability had the largest effect on the balance ratio. An alternative to raising the retirement age, to make sure that the pension system is stable in the future, could thus be to pay more or get less.

Table 13 - Pay More or Get Less

A change in level of payments in (PI) and out (PO) of the system effects the balance ratio through changes in the variables; adjusted contribution revenue (ACR), contribution revenue (CR) and liability to workers (LW) if the level of payment into the system change and pension disbursements (PD) and liability to pensioners (LP) if the level of payment out of the system change. Simulations are performed with 1% and 5% increases to the level of payments coming in to the system and 1% and 5% decreases to the level of payments going out of the system. The balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ	**Δ PI**	**1%**	**5%**		
		Δ PO			**-1%**	**-5%**
		→ Δ ACR	1%	5%		
		→ Δ CR	1%	5%		
		→ Δ PD			-1%	-5%
		→ Δ LW	1%	5%		
		→ Δ LP			-1%	-5%
2011	1.0132		1.0166	1.0297	1.0178	1.0363
2012	0.9917		0.9953	1.0094	0.9965	1.0160
2013	0.9921		0.9961	1.0117	0.9973	1.0183
2014	1.0003		1.0046	1.0214	1.0058	1.0281
2015	0.9939		0.9984	1.0161	0.9996	1.0230
2016	1.0039		1.0088	1.0276	1.0100	1.0348
2017	1.0072		1.0123	1.0319	1.0135	1.0393
2018	1.0083		1.0135	1.0340	1.0148	1.0416
2019	1.0132		1.0187	1.0400	1.0200	1.0477
2020	1.0133		1.0190	1.0410	1.0203	1.0489

We continue by looking at the combination of a change in the level of payments going in and out of the system and a change in the number of pensioners. We use the same assumptions as in each of the individual analyses. The variables being adjusted are hence; adjusted contribution revenue, contribution revenue, pension disbursements, liability to workers and liability to pensioners. The results are presented in Table 14.

First we look at the results for an increase in the level of payments into the system. For a 5% increase in the number of pensioners the balance ratio is lower in all years, than without any change, for both a 1% and 5% increase in the level of payments. The same is true for a 1% increase is the level of payments when the number of pensioners increases by 1%. However, with a 5% increase in the level of payments and a 1% increase in the number of pensioners, the balance ratio is higher in all years. This means that the increased level of payments was able to counteract the increase in the number of pensioners.

When looking at the results for the level of payments out of the system, we find that in two of the four scenarios the balance ratio is the same as with no change, as the demographic change and the policy are the exact opposites. For a 1% (5%) increase in the number of pensioners and a 5% (1%) increase in the level of payments the balance ratio is above (below) 1.00 in all 10 years.

Table 14 - Pay More or Get Less and Changes in Number of Pensioners

A change in level of payments in (PI) and out (PO) of the system, together with a change in the number of pensioners (NP), effects the balance ratio through changes in the variables; adjusted contribution revenue (ACR), contribution revenue (CR), pension disbursements (PD), liability to workers (LW) and liability to pensioners (LP) if the level of payment into the system change and pension disbursements (PD) and liability to pensioners (LP) if the level of payment out of the system change. Simulations are performed with 1% and 5% increases to the level of payments coming in to the system and 1% and 5% decreases to the level of payments going out of the system, together with 1% and 5% increase in the number of pensioners. The balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ									
		Δ PI	**1%**	**1%**	**5%**	**5%**				
		Δ PO					**-1%**	**-1%**	**-5%**	**-5%**
		Δ NP	**1%**	**5%**	**1%**	**5%**	**1%**	**5%**	**1%**	**5%**
		→ Δ ACR	1%	1%	5%	5%				
		→ Δ CR	1%	1%	5%	5%				
		→ Δ PD	1%	5%	1%	5%	0%	4%	-4%	0%
		→ Δ LW	1%	1%	5%	5%				
		→ Δ LP	1%	5%	1%	5%	0%	4%	-4%	0%
2011	1.0132		1.0121	0.9943	1.0252	1.0078	1.0132	0.9953	1.0316	1.0132
2012	0.9917		0.9906	0.9719	1.0048	0.9864	0.9917	0.9728	1.0111	0.9917
2013	0.9921		0.9910	0.9710	1.0067	0.9869	0.9921	0.9718	1.0130	0.9921
2014	1.0003		0.9992	0.9779	1.0160	0.9950	1.0003	0.9788	1.0225	1.0003
2015	0.9939		0.9928	0.9705	1.0105	0.9884	0.9939	0.9714	1.0171	0.9939
2016	1.0039		1.0027	0.9790	1.0217	0.9983	1.0039	0.9800	1.0286	1.0039
2017	1.0072		1.0060	0.9814	1.0257	1.0014	1.0072	0.9823	1.0328	1.0072
2018	1.0083		1.0070	0.9815	1.0276	1.0024	1.0083	0.9825	1.0348	1.0083
2019	1.0132		1.0119	0.9855	1.0333	1.0072	1.0132	0.9865	1.0407	1.0132
2020	1.0133		1.0121	0.9849	1.0341	1.0073	1.0133	0.9859	1.0416	1.0133

The same changes in the level of payments are applied to the case with an increase in expected longevity. The assumptions used in each of the two individual analyses are combined. The variables being adjusted are hence; adjusted contribution revenue, pay-out duration, contribution revenue, pension disbursements, liability to workers and liability to pensioners.

We find that changing the level of payments has a greater effect on an increase in expected longevity, than an increase in the number of pensioners, as can be seen in Table 15. For a 5% change in the level of payments the balance ratio is positive in all years, meaning that the change in the level of payments can be used to completely counteract a 1% and 5% increase in the number of pensioners. If the increase in longevity is 1%, a 1% increase in the level of payments is sufficient to increase the balance ratio in all years. However, a 1% increase in the level of payments is not sufficient to counteract a 5% increase in expected longevity.

Table 15 - Pay More or Get Less and Changes in Expected Longevity

A change in level of payments in (PI) and out (PO) of the system, together with a change in expected longevity (L), effects the balance ratio through changes in the variables; adjusted contribution revenue (ACR), pay-out duration (OD), contribution revenue (CR), liability to workers (LW) and liability to pensioners (LP) if the level of payment into the system change and pay-out duration (OD), pension disbursements (PD) and liability to pensioners (LP) if the level of payment out of the system change. Simulations are performed with 1% and 5% increases to the level of payments coming in to the system and 1% and 5% decreases to the level of payments going out of the system, together with 1% and 5% increase in expected longevity. The balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ	**Δ PI**	**1%**	**1%**	**5%**	**5%**				
		Δ PO					**-1%**	**-1%**	**-5%**	**-5%**
		Δ L	**1%**	**5%**	**1%**	**5%**	**1%**	**5%**	**1%**	**5%**
		→Δ ACR	1%	1%	5%	5%				
		→ Δ OD	4.15%	20.75%	4.15%	20.75%	4.15%	20.75%	4.15%	20.75%
		→Δ CR	1%	1%	5%	5%				
		→Δ PD					-1%	-1%	-5%	-5%
		→ Δ LW	1%	1%	5%	5%				
		→ Δ LP	4.15%	20.75%	4.15%	20.75%	3.15%	19.75%	-0.85%	15.75%
2011	1.0132		1.0151	1.0097	1.0286	1.0244	1.0162	1.0102	1.0344	1.0274
2012	0.9917		0.9937	0.9877	1.0082	1.0034	0.9947	0.9882	1.0140	1.0063
2013	0.9921		0.9941	0.9865	1.0100	1.0036	0.9951	0.9869	1.0157	1.0063
2014	1.0003		1.0026	0.9948	1.0197	1.0129	1.0036	0.9952	1.0256	1.0158
2015	0.9939		0.9963	0.9885	1.0143	1.0074	0.9974	0.9889	1.0204	1.0104
2016	1.0039		1.0065	0.9980	1.0256	1.0181	1.0075	0.9984	1.0320	1.0213
2017	1.0072		1.0101	1.0020	1.0300	1.0229	1.0112	1.0025	1.0366	1.0263
2018	1.0083		1.0114	1.0033	1.0321	1.0249	1.0125	1.0038	1.0388	1.0284
2019	1.0132		1.0165	1.0084	1.0380	1.0309	1.0176	1.0089	1.0449	1.0345
2020	1.0133		1.0169	1.0089	1.0391	1.0320	1.0180	1.0094	1.0461	1.0357

We now consider the alternative of changing the level of payments from workers and to pensioners simultaneously. The variables being adjusted are hence; adjusted contribution revenue, pay-out duration, contribution revenue, pension disbursements, liability to workers and liability to pensioners.

As can be seen in Table 16, the balance ratio is above 1.00 when increasing the level of payments in and decreasing the level of payments out of the system with 5% simultaneously, for both increases in the number of pensioners and the longevity with up to 5%.

Looking at an increase in the level of payments of 1%, the balance ratio is higher in all years, than with no change, when the number of pensioners increases with 1%. Still, the balance ratio is below 1.00 in 3 out of 10 years. When the number of pensioners increases with 5%, a 1% increase in the level of payments is not enough and the balance ratio is below 1.00 in all 10 years.

The level of the balance ratio is higher in the case of increased longevity. When the longevity increases with 1% and the level of payments increase with 1% the balance ratio is below 1.00 in 2 out of 10 years. With an increase of instead 5% in longevity, keeping the increase in the level of payments at 1%, the balance ratio is below 1.00 in 4 out of 10 years.

Table 16 - Pay More <u>and</u> Get Less and Changes in Number of Pensioners and Expected Longevity

A simultaneous change in level of payments in (PI) and out (PO) of the system, is combined with an increase in the number of pensioners (NP) and an increase expected longevity (L), to see the effects on the balance ratio. Looking at a change in the number of pensioners (NP) the following variables are changed; adjusted contribution revenue (ACR), contribution revenue (CR), pension disbursements (PD), liability to workers (LW) and liability to pensioners (LP). For the change in longevity (L) the following variables are used; adjusted contribution revenue (ACR), pay-out duration (OD), contribution revenue (CR), pension disbursements (PD), liability to workers (LW) and liability to pensioners (LP). Simulations are performed with 1% and 5% simultaneous increases in the level of payments. The balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ										
		Δ PI	**1%**	**1%**	**5%**	**5%**	**1%**	**1%**	**5%**	**5%**
		Δ PO	**-1%**	**-1%**	**-5%**	**-5%**	**-1%**	**-1%**	**-5%**	**-5%**
		Δ NP	**1%**	**5%**	**1%**	**5%**				
		Δ L					**1%**	**5%**	**1%**	**5%**
		→Δ ACR	1%	1%	5%	5%	1%	1%	5%	5%
		→ Δ OD					4.15%	20.75%	4.15%	20.75%
		→Δ CR	1%	1%	5%	5%	1%	1%	5%	5%
		→Δ PD	0%	4%	-4%	0%	-1%	-1%	-5%	-5%
		→ Δ LW	1%	1%	5%	5%	1%	1%	5%	5%
		→ Δ LP	0%	4%	-4%	0%	3.15%	19.75%	-0.85%	15.75%
2011	1.0132		1.0166	0.9987	1.0477	1.0297	1.0196	1.0139	1.0509	1.0455
2012	0.9917		0.9953	0.9765	1.0285	1.0094	0.9984	0.9922	1.0317	1.0256
2013	0.9921		0.9961	0.9759	1.0322	1.0117	0.9992	0.9913	1.0353	1.0274
2014	1.0003		1.0046	0.9831	1.0432	1.0214	1.0080	0.9998	1.0466	1.0382
2015	0.9939		0.9984	0.9760	1.0389	1.0161	1.0020	0.9937	1.0424	1.0339
2016	1.0039		1.0088	0.9849	1.0519	1.0276	1.0124	1.0036	1.0555	1.0462
2017	1.0072		1.0123	0.9875	1.0571	1.0319	1.0163	1.0078	1.0611	1.0521
2018	1.0083		1.0135	0.9878	1.0601	1.0340	1.0178	1.0093	1.0643	1.0552
2019	1.0132		1.0187	0.9921	1.0670	1.0400	1.0232	1.0147	1.0715	1.0623
2020	1.0133		1.0190	0.9916	1.0688	1.0410	1.0237	1.0154	1.0734	1.0643

The balance ratio given a 1% simultaneous increase is lower than the value of the balance ratio given a 5% increase in either the level in or out. However, given a simultaneous change of 5% the balance ratio ends up above that given a 1 year raise of retirement age, in both the case of increased number of pensioners and increased expected longevity. The highest balance ratios, in either of the two cases, are however for a 2 year raise in retirement age.

D. Changes in Financial Factors

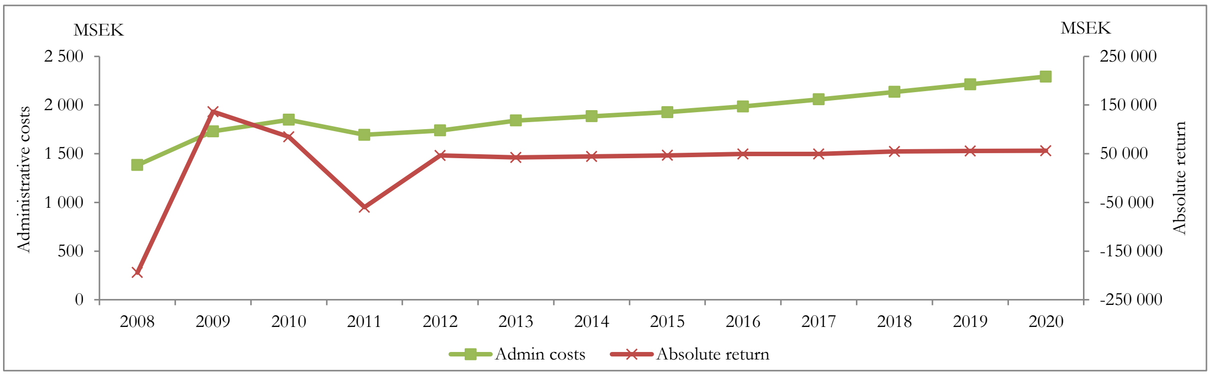
The purpose of the buffer fund is to build up reserves when the contribution revenue is larger than pension disbursements, to support the pension system when the contribution revenue is smaller than pension disbursements. The buffer fund hence neutralises the fluctuations in demographic factors. Therefore it is interesting to see how the net flow has developed the last years and how it is expected to develop in the near future. As can be seen in Figure 3, the net flow has had and will continue to experience a negative trend. The development of the net flow puts pressure on the buffer fund's ability to support the system. Thus, the analysis of the buffer fund is of great interest and importance. The analysis will consider the following financial factors; return, cost, size and asset allocation of the buffer fund.

The Effect on the Balance Ratio from Changes in the Return of the Buffer Fund

The fact that the result of the buffer fund has not been satisfactory, makes it interesting to look closer both at the return and cost structure of the fund. As can be seen in Figure 8, the return in absolute numbers varied a lot during the financial crisis and still does today. The return is expected to stabilise, but the costs are experiencing an increasing trend. Because of the debate of low returns, the following analysis looks into the effect of increases in the return on the balance ratio.

Figure 8 - Absolute Return and Administration Costs of the Buffer Fund

The absolute return and administration costs of the buffer fund in MSEK, for the period 2008-2020.



Source: The Swedish Pensions Agency, 2011

The analysis is performed under the assumptions that no other factors are affected by the increase in return. As stated, the absolute return is given after the deduction of performance based fees and transaction costs such as commission and the deduction of provision costs, which are fees not based on performance (Swe. ej resultatbaserade avgifter). The variable adjusted in the analysis is absolute return before deduction of provision costs. The variable provision costs is not altered.

In the simulations a change in return is hence assumed to affect the balance ratio through changes in the variable; absolute return before deduction of provision costs. We simulate changes of 1% and 5% in return to see the effect on the balance ratio in the years 2011-2020.

As can be seen in Table 17, an increase in return has a positive effect on the balance ratio. However, the effects are not large and for both a 1% and 5% increase the balance ratio is still below 1.00 in 3 out of 10 years.

Table 17 - Return of the Buffer Fund

A change in the return (R), effects the balance ratio through changes in the variable; absolute return before deduction of provision costs (RD). Simulations are performed with an increase in return of 1% and 5%. The balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ	Δ R → Δ RD	1% 1%	5% 5%
2011	1.0132		1.0132	1.0133
2012	0.9917		0.9917	0.9919
2013	0.9921		0.9922	0.9924
2014	1.0003		1.0004	1.0009
2015	0.9939		0.9941	0.9947
2016	1.0039		1.0041	1.0049
2017	1.0072		1.0074	1.0084
2018	1.0083		1.0085	1.0097
2019	1.0132		1.0135	1.0149
2020	1.0133		1.0137	1.0152

To see to what extent an increase in return can counteract changes in demographic factors, we look at the two scenarios; an increase in the number of pensioners and longevity. The assumptions made in the individual analyses are combined with the assumptions from the return analysis. In the simulations a change in return together with a change in the number of pensioners is hence assumed to affect the balance ratio through changes in the variables; pension disbursements, absolute return before deduction of provision costs and liability to pensioners. A change in return together with a change in expected longevity is assumed to affect the balance ratio through changes in the variables; pay-out duration, absolute return before deduction of provision costs and liability to pensioners. The results can be found in Table 18.

The effect of adding the return is positive, but it is not enough to counteract an increase in either the number of pensioners or expected longevity of 1%. Thus, the buffer fund is too small to compensate for such increases. Comparing the values of the balance ratio in the two different scenarios, we find that they are higher in the case of expected longevity. This is reasonable since the effects are more severe for increases in the number of pensioners of the same size as increases in longevity, as concluded in previous analyses.

A larger increase in the return than 5% does not seem realistic. Since a 5% increase in return does not manage to overcome a 1% increase in number of pensioners or a 1% increase in longevity, changing the size of the buffer fund could be an option. This will be discussed in the "Size" section.

Table 18 - Return of the Buffer Fund and Changes in Number of Pensioners and Expected Longevity

A change in return (R), in combination with changes in number of pensioners (NP) and expected longevity (L), effects the balance ratio through changes in the variable; pension disbursements (PD), absolute return before deduction of provision costs (RD) and liability to pensioners (LP) and pay-out duration (OD), absolute return before deduction of provision costs (RD) and liability to pensioners (LP) respectively. Simulations are performed with an increase in return and cost of 1% and 5%. The balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ									
		Δ R	**1%**	**1%**	**5%**	**5%**	**1%**	**1%**	**5%**	**5%**
		Δ NP	**1%**	**5%**	**1%**	**5%**				
		Δ L					**1%**	**5%**	**1%**	**5%**
		→ Δ OD					4.15%	20.75%	4.15%	20.75%
		→ Δ RD	1%	1%	5%	5%	1%	1%	5%	5%
		→ Δ PD	1%	5%	1%	5%				
		→ Δ LP	1%	5%	1%	5%	4.15%	20.75%	4.15%	20.75%
2011	1.0132		1.0087	0.9909	1.0088	0.9910	1.0117	1.0059	1.0118	1.0060
2012	0.9917		0.9870	0.9682	0.9872	0.9684	0.9900	0.9838	0.9903	0.9840
2013	0.9921		0.9870	0.9669	0.9873	0.9672	0.9901	0.9822	0.9903	0.9825
2014	1.0003		0.9950	0.9736	0.9954	0.9740	0.9983	0.9902	0.9988	0.9906
2015	0.9939		0.9884	0.9660	0.9890	0.9666	0.9919	0.9837	0.9925	0.9843
2016	1.0039		0.9981	0.9743	0.9989	0.9751	1.0017	0.9930	1.0026	0.9937
2017	1.0072		1.0011	0.9765	1.0022	0.9775	1.0052	0.9969	1.0062	0.9978
2018	1.0083		1.0020	0.9764	1.0032	0.9776	1.0063	0.9980	1.0075	0.9991
2019	1.0132		1.0068	0.9803	1.0081	0.9816	1.0113	1.0030	1.0126	1.0042
2020	1.0133		1.0068	0.9795	1.0082	0.9809	1.0115	1.0033	1.0130	1.0047

The Effect on the Balance Ratio from Changes in the Cost of the Buffer Fund

The debate in media regarding the potential change in the number of National Pension Funds makes it interesting to look at the cost of the buffer fund and the effect on the balance ratio from a potential change in the cost. As can be seen in Figure 8 the return in absolute numbers varied a lot during the financial crisis and still does today. The return is expected to stabilise, but the costs are experiencing an increase. To see the effect of such an increase we look closer at the effects of changes in the cost on the balance ratio.

In the simulations, a change in cost is hence assumed to affect the balance ratio through changes in the variables; administrative costs and provision costs. We simulate changes, ranging from -25% to 25%, in the cost to see the effect on the balance ratio in the years 2011-2020. The values of the provision cost and administrative costs are assumed to change as much.

As can be seen in Table 19, increases and decreases in costs of the buffer fund, do not have a large impact on the balance ratio. The balance ratio is below 1.00 in 3 out 10 years for all levels of changes in the cost, except for a 25% increase. The balance ratio is below 1.00 in 4 out of 10 years for an increase in costs of 25%. Thus, a merge of the National Pension Fund is likely to have little effect on the balance ratio through cost reduction.

Since changes in costs do not have large effects on the balance ratio it would be interesting to see if it could be beneficial to actually increase the costs as a means to increase the return. We perform simulations with changes in the return and cost of the buffer fund to see the effect on the balance ratio, changing the variables; absolute return before deduction of provision costs, provision costs and administration costs.

Table 19 - Cost of the Buffer Fund

A change in the cost (C), effects the balance ratio through changes in the variable; provision cost (PC) and administration cost (AC). Simulations are performed with an increase in cost of 1% and 5%. The balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ	Δ C	-25%	-10%	-5%	-1%	1%	5%	10%	25%
		→ Δ PC	-25%	-10%	-5%	-1%	1%	5%	10%	25%
		→ Δ AC	-25%	-10%	-5%	-1%	1%	5%	10%	25%
2011	1.0132		1.0135	1.0133	1.0133	1.0132	1.0132	1.0132	1.0131	1.0129
2012	0.9917		0.9920	0.9918	0.9917	0.9917	0.9917	0.9916	0.9915	0.9913
2013	0.9921		0.9925	0.9923	0.9922	0.9921	0.9921	0.9920	0.9919	0.9917
2014	1.0003		1.0008	1.0005	1.0004	1.0003	1.0003	1.0002	1.0001	0.9998
2015	0.9939		0.9944	0.9941	0.9940	0.9939	0.9939	0.9938	0.9937	0.9934
2016	1.0039		1.0045	1.0041	1.0040	1.0039	1.0039	1.0038	1.0037	1.0033
2017	1.0072		1.0078	1.0074	1.0073	1.0072	1.0072	1.0071	1.0069	1.0066
2018	1.0083		1.0089	1.0085	1.0084	1.0083	1.0082	1.0081	1.0080	1.0076
2019	1.0132		1.0139	1.0135	1.0133	1.0132	1.0132	1.0131	1.0129	1.0125
2020	1.0133		1.0141	1.0136	1.0135	1.0134	1.0133	1.0132	1.0130	1.0126

We find that, increasing the level of cost and return has a positive effect on the balance ratio, as seen in Table 20. The difference between the value of the balance ratios in the simulation and with no change is higher in the later years, but the effect is overall very limited.

Table 20 - Cost of the Buffer Fund and Changes in the Return

A change in the cost (C) and return (R) effects the balance ratio through changes in the variable; absolute return before deduction of provision costs (RD), provision cost (PC) and administration cost (AC). Simulations are performed with an increase in cost and return of 1% and 5%. The balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ	Δ R	1%	5%	1%	5%
		Δ C	1%	1%	5%	5%
		→ Δ RD	1%	5%	5%	5%
		→ Δ PC	1%	1%	5%	5%
		→ Δ AC	1%	1%	5%	5%
2011	1.0132		1.0132	1.0133	1.0132	1.0133
2012	0.9917		0.9917	0.9919	0.9917	0.9919
2013	0.9921		0.9921	0.9924	0.9921	0.9923
2014	1.0003		1.0004	1.0009	1.0003	1.0008
2015	0.9939		0.9940	0.9947	0.9940	0.9946
2016	1.0039		1.0041	1.0049	1.0040	1.0048
2017	1.0072		1.0074	1.0084	1.0073	1.0083
2018	1.0083		1.0085	1.0097	1.0084	1.0096
2019	1.0132		1.0135	1.0148	1.0134	1.0147
2020	1.0133		1.0137	1.0152	1.0136	1.0150

The Effect on the Balance Ratio from Changes in the Size of the Buffer Fund

The analyses above has shown that the ability of the buffer fund to compensate for changes in demographic factors such as increases in number of pensioners is limited. Another option could be to increase the size of the buffer fund by some means to increase the effect on the pension system and the ability of the buffer fund to work as a neutralising tool.

When the size of the buffer fund is changed, the return and the cost are also assumed to change, while contribution income and pension disbursements remain unchanged. The variables being adjusted are hence; the value of the buffer fund, absolute return before deduction of provision costs, provision costs and administration costs. The assumption is made that the variables change with the same percentage respectively.

As can be seen in Table 21, an increase in capital, leading to an increase in cost and return, has a positive effect on the balance ratio. For a 5% increase the balance ratio is above 1.00 in all years. For an increase of 1% the balance ratio is above 1.00 in 8 out of 10 years.

Thus, increasing the power of the neutralising tool that the buffer fund represents has a positive effect on the balance ratio and could be an option instead of e.g. changing retirement age or the percentage that each worker contribute to the system. There would be no strikes as there have been in Europe but the question is though, where would the money come from? And is it preferable to move to a more funded pension system?

Table 21 - Size of the Buffer Fund

A change in the size of capital (S) effects the balance ratio through changes in the variable; value of buffer fund (BF), absolute return before deduction of provision costs (RD), provision cost (PC) and administration cost (AC). Simulations are performed with an increase of 1% and 5%. The balance ratio is provided for the years 2011-2020.

Year	Balance ratio without Δ	Δ S	-5%	-1%	1%	5%
		→ Δ BF	-5%	-1%	1%	5%
		→ Δ RD	-5%	-1%	1%	5%
		→ Δ PC	-5%	-1%	1%	5%
		→ Δ AC	-5%	-1%	1%	5%
2011	1.0132		0.9929	1.0089	1.0177	1.0370
2012	0.9917		0.9679	0.9865	0.9971	1.0209
2013	0.9921		0.9650	0.9861	0.9984	1.0270
2014	1.0003		0.9701	0.9935	1.0075	1.0410
2015	0.9939		0.9611	0.9864	1.0020	1.0402
2016	1.0039		0.9686	0.9957	1.0128	1.0561
2017	1.0072		0.9700	0.9984	1.0168	1.0650
2018	1.0083		0.9698	0.9990	1.0185	1.0710
2019	1.0132		0.9737	1.0035	1.0240	1.0807
2020	1.0133		0.9732	1.0033	1.0246	1.0853

The Asset Allocation of the Buffer Fund

When it was decided on the number of National Pension Funds the advantage of diversification was an important consideration. However, the National Pension Funds, making up the buffer fund, do not differ much in their allocation of assets today, as can be seen in Table 2. Only the asset allocation of the sixth National Pension Fund is significantly different. Since it is much smaller, value-wise, compared to the other four, this does not affect the total allocation to a great extent. The similarity could be a consequence of the investment rules that the First-Fourth National Pension Funds abide.

To see the difference in return and standard deviation given the choice of asset allocation we construct four portfolios, which can be seen in Table 22. Portfolio 1 represents the asset allocation of the buffer fund as it approximately is today, Portfolio 2 is an equal-weighted portfolio, Portfolio 3 is the optimal portfolio, with the highest possible Sharpe ratio given the assets available and Portfolio 4 is the least optimal portfolio, with the lowest possible Sharpe ratio given the assets available. Looking at the best and worst allocation of assets, given the investment rules, provides an understanding of the range of possible outcomes for the investment management. Hence, when finding the optimal and the least optimal portfolios, two of the investment rules of the buffer fund; maximum exposure to currency risk of 40% and minimum allocation in low-risk assets of 30% are used as restrictions. Removing the restrictions, the same portfolios remain the optimal and the least optimal.

We find that the portfolios differ much in their levels of return and standard deviation. Portfolio 3 has the highest Sharpe ratio. The Sharpe ratios of Portfolio 1 and 2 are similar, while they differ in their return and standard deviation. Portfolio 4 has a negative Sharpe ratio.

To learn how Portfolio 1, which is the representation of the current portfolio held by the National Pension Funds, would perform in a downturn in the economy we run a simulation, over a period of 10 years. With an initial value of 100, the portfolio is subjected to a negative shock in the first year, followed by an upturn in the second year. During the subsequent eight years the return of the portfolio is modelled using the expected return and standard deviation established above for Portfolio 1. The simulation is run 10 000 times, and the value at the end of the tenth year is registered each time, to obtain the spread in values. The result from the simulation can be found in Table 23.

Table 22 - Four Alternative Asset Allocations

Four portfolios are constructed using 20 assets; Portfolio 1 represents the asset allocation of the buffer fund as it approximately is today, Portfolio 2 is an equal-weighted portfolio, Portfolio 3 is the optimal portfolio, with the highest possible Sharpe ratio, and Portfolio 4 is the least optimal portfolio, with the lowest possible Sharpe ratio. The expected return, standard deviation and Sharpe ratio are stated for each of the portfolios.

Portfolio	**1**	**2**	**3**	**4**
MSCI All Country World Price Index	0.3750	0.0500	0.0000	0.0000
FTSE Global Government US 1-3 years	0.0233	0.0500	0.1811	0.0000
FTSE Global Government US 7-10 years	0.0233	0.0500	0.0000	0.0000
FTSE Global Government Euro-zone 1-3 years	0.0233	0.0500	0.0000	0.1571
FTSE Global Government Euro-zone 7-10 years	0.0233	0.0500	0.0000	0.0000
Dow Jones Corporate 2-year index	0.0233	0.0500	0.0000	0.0000
Dow Jones Corporate 10-year index	0.0233	0.0500	0.0000	0.0000
FTSE Euro Corporate (ex.Banks) 1-3 years	0.0233	0.0500	0.0000	0.0000
FTSE Euro Corporate (ex.Banks) 7-10 years	0.0233	0.0500	0.0000	0.0000
MSCI EAFE Currency Index	0.0000	0.0500	0.1825	0.0000
S&P/TSX Global Gold Index	0.0000	0.0500	0.0000	0.0000
S&P GSCI All Wheat Spot	0.0000	0.0500	0.0101	0.0000
Crude Brent Oil Price	0.0020	0.0500	0.0212	0.0008
OMXS 30 Index	0.2020	0.0500	0.0834	0.0000
FTSE Global Government Sweden 1-3 years	0.0875	0.0500	0.0000	0.8420
FTSE Global Government Sweden 7-10 years	0.0875	0.0500	0.5143	0.0000
Sweden Krona Index	0.0200	0.0500	0.0000	0.0000
Electricity Sweden Month Average	0.0000	0.0500	0.0074	0.0000
OMX Stockholm Metals & Mining Price Index	0.0200	0.0500	0.0000	0.0000
OMX Stockholm Paper & Forest Products Price Index	0.0200	0.0500	0.0000	0.0000
Expected return	**0.0260**	**0.0164**	**0.0123**	**-0.0032**
Standard deviation	**0.0773**	**0.0485**	**0.0183**	**0.0076**
Sharpe ratio	**0.3368**	**0.3371**	**0.6688**	**-0.4159**

Table 23 - Performance Modelling of the Buffer Fund

Portfolio 1 represents the current portfolio held by the buffer fund. To see how the portfolio would be effected by a downturn this is simulated, during a period of 10 years. With an initial value of 100, the portfolio is subjected to a negative shock in the first year, followed by an upturn in the second year. During the subsequent eight years the return of the portfolio is modelled using the expected return and standard deviation of the portfolio. This is simulated 10 000 times, and the value at the end of the tenth year is registered each time. The percentage amount of times that the value ends up in each of the ten intervals is registered.

Spread in end value	**Portfolio 1**
Value 180-200	0.02%
Value 160-179	0.12%
Value 140-159	0.65%
Value 120-139	5.02%
Value 100-119	19.34%
Value 80-99	38.66%
Value 60-79	31.41%
Value 40-59	4.78%
Value 20-39	0.00%
Value 0-19	0.00%

We find that most frequently, the value of the portfolio in the tenth year ends up in the interval 80-99, which is below the initial value of 100. The value at the end of the tenth year is equal to or above the initial value, 100, only 25.15% of the time. It could be argued that a ten year period is a short time to recover, given the expected return of the portfolio and the substantial downturn, but given the frequency of downturns fast recovery is crucial. The result is interesting because of the neutralising mechanism that the buffer fund represents. Meanwhile there is additional pressure on the pension system because of changes in demographic factors.

Finally, to simulate the effect of asset allocation on the balance ratio three portfolios are used; Portfolio 1, Portfolio 2 and Portfolio 3. The absolute return before deduction of provision costs is replaced with returns from the three respective portfolios to see the effect on the balance ratio. We model the return for each year, using the expected return and standard deviation of each portfolio. The return is then multiplied with the value of the buffer fund at the beginning of each year, to get the absolute return. This is then used instead of the value for absolute return before deduction of provision costs stated by the Swedish Pensions Agency. The simulation is run 10 000 times using each of the three portfolios and the portion of times that the balance ratio is equal to or larger than 1.00 in each year, is registered for the period 2011-2020.

The results can be found in Table 24, where we see that Portfolio 3 has the highest portion of balance ratios equal to or larger than 1.00 in 2011, but a significant lower portion than Portfolio 1 and 2 all of the years that follow. For Portfolio 1, which has the lowest Sharpe ratio, the balance ratio is equal to or larger than 1.00 most often. However, both the expected return and standard deviation are higher than those for Portfolio 2 and 3. Compared to Portfolio 3, Portfolio 2 has a slightly higher return but a much higher standard deviation and has significantly higher portions of balance ratios equal to or larger than 1.00. Thus, although Portfolio 2 has a lower Sharpe ratio and higher standard deviation than Portfolio 3, it performs better in this simulation. Hence, it seems that a higher standard deviation in this case increases the chance of the balance ratio being equal to or larger than 1.00. However, the spread of the balance ratio is not revealed in the simulation. It is possible that Portfolio 2 has a larger spread in the value of balance ratios, while the balance ratio for Portfolio 3 is lower on average but with a more narrow spread.

Table 24 - The Effect of Asset Allocation on the Balance Ratio

To see the effect of the asset allocation on the balance ratio simulations are performed using three different portfolios. Portfolio 1 represents the asset allocation of the buffer fund as it approximately is today, Portfolio 2 is an equal-weighted portfolio, Portfolio 3 is the optimal portfolio, with the highest possible Sharpe ratio given the assets available. The expected return and standard deviation is presented for each portfolio. Using these characteristics the return for each of the portfolios is modelled for the period 2011-2020, which is then multiplied with the value of the buffer fund at the beginning of the year, to get the absolute return. The balance ratio is simulated for the years 2011-2020, replace the variable; absolute return before deduction of provision costs with the absolute return of each portfolio. The simulation is run 10 000 times using portfolio 1,2 and 3 respectively and the portion of times that the balance ratio is equal to or larger than 1.00 is registered. The percentage times out of the simulations that this occurred is registered for each year.

	Portfolio 1	Portfolio 2	Portfolio 3
Expected return	0.0260	0.0164	0.0123
Standard deviation	0.0773	0.0485	0.0183
2011	90.38%	96.14%	100.00%
2012	49.25%	33.47%	5.66%
2013	52.05%	36.16%	8.31%
2014	60.65%	50.48%	30.46%
2015	44.46%	25.03%	1.02%
2016	55.98%	40.15%	10.81%
2017	56.18%	39.60%	9.58%
2018	53.06%	33.86%	4.05%
2019	55.54%	37.29%	6.45%
2020	50.75%	29.76%	1.92%

VII. Empirical Validity

A. Limitations of the Model

The Swedish Pensions Agency's model used in the analysis, which is the one provided in the Orange report 2010, might be refined in the future. The Government has assigned the Swedish Pensions Agency to evaluate different ways of calculating the pension liability, since the view of Försäkringskassan is that the existing rules make the balance ratio fluctuate too much. The Swedish Pensions Agency has reached the conclusion that certain changes should be made, but that rulings also have to be changed to be able to make adjustments to the model (The Swedish Pensions Agency, 2010). Because of that, the methodology for calculating the pension liability may be different in the future from what is used in this thesis. However, the model used in the thesis is the one used in the pension system today and if and when possible changes might be incorporated is not known.

The formulas stated in the Orange report 2010, which are used throughout this paper, are simplified versions of what is used in the analysis at the Swedish Pensions Agency. Though the analysis performed in this paper is focused on the effects on a broad level, why more detailed formulas are not considered to add value.

The use of simulations requires assumptions, which are of great importance for the outcome of the tests. As the model does not have variables representing for example the number of pensioners, birth rate and legal retirement age assumptions have to be made, determining the size of the effect on variables in the model that a change in a certain factor has. Even though the assumptions are not an exact representation of reality the size of the changes should be considered in relation to each other, within each simulation. The fact the supplementary pension (Swe. tilläggspension) and other remnants from the old pension system do not respond to changes in the factors in exactly the same way as their counterparts in the new system is not taken into account.

In our simulations we do not "activate" the balance mechanism if the balance ratio falls below 1.00, meaning that corrections restoring the balance are not made. Although this is not realistic, in the way that it is not a true representation of reality, is gives a clear picture of how often the problem will occur, given no intervention.

B. Limitations of the Data

In the different simulations, the forecast data provided by the Swedish Pensions Agency is used as a starting point. These assumptions in turn come from different statistical authorities, such as SCB. To make own assumptions would be too extensive with regards to the focus of the thesis.

In the choice of indices to include in the construction of the portfolios some adjustments have been made that might not be optimal. Regarding the gold index for example, it is an index of gold companies around the world rather than a world index of gold as a commodity. The same type of adjustment is the case for a few other indices. This is stated in the description of the indices in Appendix B. Though, these adjustments have been made with the aim of obtaining as good representations of the development of the underlying asset as possible.

The fact that the base date varies between the assets is a factor of uncertainty, as expected returns vary much over time. However, to get an as good estimation as possible of the expected return for each asset, we have chosen to use as much data as possible.

VIII. Concluding Remarks

As the population ages there are potential effects in several areas of social, political and economic life. The fact that ageing will affect pension systems is not disputed. The extent of the effects and the vulnerability of pension systems is however not clear. Characteristics of different pension systems will be determinants of how well the systems achieve stability and sustainability.

The Swedish public pension system obtains stability through the automatic balancing mechanism, assuring that assets and liabilities maintain a proper size in relation to each other. However, demographic, economic (such as wage, inflation, unemployment etc.) and financial factors (such as performance of stock markets, asset allocation etc.) affect how often the automatic balancing is activated. As an activated balance mechanism implies lower levels of pensions disbursements, it has great implications for pensioners.

The factors most affecting the stability of Pay-As-You-Go (PAYG) systems are demographic factors. As the buffer fund constitutes a neutralising feature, when for example net contributions are negative, it is important to study the impact of financial factors. Hence, we ask how much demographic and financial factors influence the balance ratio in the Swedish pension system.

Using simulations, four demographic scenarios are tested including changes to the; number of pensioners, longevity, immigration and birth rate. Two potential policy changes; retirement age and level of payments in and out of the system, are thereafter tested, to see if these can be used to counteract an increase in the number of pensioners and expected longevity. In the financial part of the analysis four different aspects are considered with changes to; the return, cost, size and asset allocation of the buffer fund.

We find that demographic factors have a great impact on the long term stability. The buffer fund also has an important neutralising effect in the short term. In more detail, an increase in the number of pensioners and an increased longevity put much strain on the pension system. However, these can be counteracted with policy changes, where delayed retirement age has the biggest effect. On the other hand increased immigration and birth rate have a positive effect on the balance ratio, in the short term and long term respectively. Increased return in the buffer fund has a smaller positive effect on the balance ratio. Changes in the cost of the buffer fund have little effect on the balance ratio. An increase in the size of the buffer fund can however enhance the effect of the buffer fund in neutralising fluctuations in demographic factors. The asset allocation greatly affects the buffer fund's ability to recover after turbulence in the market and are hence important to take into consideration when looking at the effects of financial factors.

The results confirm that the Swedish pension system, which is a PAYG system, is highly sensitive to changes in demographic factors and not as sensitive to changes in financial factors, Increasing the size of the buffer fund would represent a shift toward a more funded system. While this entails risk, it could decrease the sensitivity of the system to changes in demographic factors and also increase the magnitude of the buffer fund as a neutralising mechanism.

As performance of stock markets is greatly correlated with economic factors affecting the pension system, such as unemployment, it would be interesting to investigate these effects in more detail. However, to do this the model needs to be developed further.

Another idea for further research is to look at how predictive variables can be included in the model. In this way, not only the current situation, but also future developments in important factors can be captured. The US and Japan estimate the expected income in the pension system for more than 70 years ahead, while Sweden only look at the actual value of contributions. Not making projections gives a poor view of the sustainability of the total system, according to Boado-Penas et al (2009). However, it can be discussed whether predictive factors, which are not certain, should be able to generate effects that could activate the automatic balancing and impact pensioners of today.

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Appendix A - Variables in Model of the Pension System

Variables used as input in the simulations of the pension system (Orange report, 2010):

Absolute return – The absolute return in year t is given after the deduction of performance based fees and transaction costs such as commission and the deduction of provision costs, which are fees not based on performance (Swe. ej resultatbaserade avgifter). Absolute return is used in the calculations of the value of the buffer fund in each year.

Absolute return before deduction of provision costs – Used to calculated the absolute return of the buffer fund.

Administration costs – Used in the calculation of the value of the buffer fund.

Adjusted contribution revenue (Swe. utjämnad avgiftsinkomst) – The value of contribution revenue is smoothed over three years and adjusted using the June-value of the Consumer Price Index (CPI):

$$ACR(t) = \frac{CR(t) + CR(t-1) + CR(t-2)}{3} * \left(\frac{CR(t)}{CR(t-3)} * \frac{CPI(t-3)}{CPI(t)}\right)^{\frac{1}{3}} * \left(\frac{CPI(t)}{CPI(t-1)}\right)$$

where:

$ACR(t)$ = adjusted contribution asset, year t

$CR(t)$ = contribution asset, year t

$CPI(t)$ = consumer-price-index for June, year t

Buffer fund – Consists of the First, Second, Third, Fourth and Sixth National Pension Funds. The buffer fund neutralises the effect of variations in contribution revenue and pensions disbursements, caused by fluctuations in demographic and economic factors. The value of the buffer fund is given by the value at the beginning of the year, plus the contribution revenue and absolute return, minus the pension disbursements and administration costs.

Contribution revenue (Swe. avgiftsinkomst) – The sum of all contributions paid into the system during one year. The contribution revenue is used both in the calculation of the average value of the buffer fund and to get the adjusted contribution revenue (Swe. utjämnad avgiftsinkomst) used to estimate the contribution asset (Swe. avgiftstillgång).

Income index – The income index is a measure of the development of real income in Sweden. The change of the income index is based on an average over three years. The income index is replaced by the balance index when the automatic balancing mechanism is activated.

Liability to pensioners – The value of the liability to pensioners is the annual pension amount for each age group multiplied by the economic annuity divisor (Swe. ekonomiskt delningstal) for the same age group.

Liability to workers – The value of the liability to workers is the sum of the pension balance (Swe. pensionsbehållning) for each individual working.

Pay-in duration (Swe. intjänandetid) – The number of years between the expected average age of earning pension credits (Swe. pensionsrätt), time of contributions paid in, and the expected average age of retirement.

Pay-out duration (Swe. utbetalningstid) – The number of years between the expected average age of retirement and the expected average time of pension disbursements.

Pension disbursements – The sum of outgoing payments to pensioners each year.

Provision costs – Sum of fees not based on performance (Swe. ej resultatbaserade avgifter). Provision costs are used to calculate the absolute return of the buffer fund.

Other variables used in the model:

Average value of buffer fund – Given by taking the average of the value of the buffer fund in year t, t-1 and t-2. The average value of the buffer fund and the contribution asset make up the total pension asset. If dividing the pension asset with the pension liability the balance ratio is obtained.

Contribution asset – The value of the contributions coming into the income pension system. The contribution asset is calculated by multiplying the turnover duration and the adjusted contribution revenue. The contribution asset and the average value of the buffer fund together make up the total pension asset. If dividing the pension asset with the pension liability the balance ratio is obtained.

Pension liability – The sum of the liability to workers and the liability to pensioners. If dividing the pension asset, consisting of the contribution asset and the average value of the buffer fund, with the pension liability the balance ratio is obtained.

Turnover duration – The turnover duration is the number of years between the expected average age of earning pension credits (Swe. pensionsrätt), time of contributions paid in, and the expected average time of pension disbursements. The turnover duration is the sum of the pay-in duration and the pay-out duration. Turnover duration is used to calculate the contribution asset (Swe. avgiftstillgång), by multiplying it with the adjusted contribution revenue (Swe. avgiftsinkomst).

Appendix B - Description of Assets

Description of each asset, as provided by Datastream:

Crude Brent Oil Price - Crude Brent oil, free on board, per barrel. (Base date 1987-05-20)

Dow Jones Corporate 2-year and 10-year index - It is an equally weighted basket of 96 recently issued investment-grade corporate bonds with laddered maturities. The index intends to measure the return of readily tradable, high-grade U.S. corporate bonds. (Base date 1996-12-31)

Electricity Sweden Month Average - Electricity Sweden Month Average Swedish Krona per Megawatt Hour. This is Sweden average prices from Nordpool. (Base date 1996-01-01)

FTSE Euro Corporate (ex. Banks) 1-3 and 7-10 years - The FTSE Euro Corporate Bond Index includes Euro denominated issues from global corporate entities covering debt from Consumer and Industrial Goods, Utilities, Telecommunications, Information Technology and Non-Financial sectors. The index constituents are investment grade debt with a minimum rating of BBB-. We have chosen ex. Banks since the total series are from 2006. It is the to Sweden most similar corporate bond index we can find. (Base date 1999-07-02)

FTSE Global Government Euro-zone 1-3 and 7-10 years - The FTSE Global Government Bond Indices consist of central government debt from 23 countries denominated in the domicile currency. There is a Euro aggregate index and the indices are organised by region; Asia Pacific (including China), Americas and Eurozone plus a Europe ex-Eurozone index. The indices are also available at the country level and by maturity band. (Base date 1998-05-01)

FTSE Global Government Sweden 1-3 and 7-10 years - The FTSE Global Government Bond Indices consist of central government debt from 23 countries denominated in the domicile currency. (Base date 1999-12-30)

FTSE Global Government US 1-3 and 7-10 years - The FTSE Global Government Bond Indices consist of central government debt from 23 countries denominated in the domicile currency. (Base date 1999-12-30)

MSCI All Country World Price Index - The MSCI ACWI Index is a free float-adjusted market capitalization weighted index that is designed to measure the equity market performance of developed and emerging markets. The MSCI ACWI consists of 45 country indices comprising 24 developed and 21 emerging market country indices. The developed market country indices included are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, the United Kingdom and the United States. The emerging market country indices included are: Brazil, Chile, China, Colombia, Czech Republic, Egypt, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Morocco, Peru, Philippines, Poland, Russia, South Africa, Taiwan, Thailand, and Turkey. (Base date 1987-12-31)

MSCI EAFE Currency Index - The MSCI EAFE Index (Europe, Australasia, Far East) is a free float-adjusted market capitalization index that is designed to measure the equity market performance of developed markets, excluding the US & Canada. The MSCI EAFE Index consists of the following 22 developed market country indices: Australia, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Israel, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, and the United Kingdom. (Base date 1992-05-29)

OMX Stockholm Metals & Mining_PI - It is one of the GICS classified level three sector index for Metals and Mining. It is a market value-weighted index. (Base date 1995-12-29)

OMX Stockholm Paper & Forest Products_PI - It is one of the GICS classified level three sector index for Paper and Forestry Products. It is a market value-weighted index. (Base date 1995-12-29)

OMXS 30 Index - The OMX Stockholm 30 is a stock market index for the Stockholm Stock Exchange. It is a market value-weighted index that consists of the 30 most-traded stocks. (Base date 1986-01-02)

Sweden Krona Index 2000=100 (JPM) NB - It is an exchange rate series from JP Morgan for Swedish Krona to Swedish Krona which is trade weighted. This is based on 2000=100. (Base date 1994-01-04)

S&P GSCI All Wheat Spot - The S&P GSCI is widely recognised as the leading measure of general commodity price movements and inflation in the world economy. It comprises the commodities: Wheat, Corn, Soybeans, Cotton, Sugar, Coffee, and Cocoa, and is part of a series of sub-indices representing components of the S&P GSCI across a number of commodity sectors: Agriculture, Energy, Industrial Metals, Precious Metals, Softs, and Livestock. Wheat component includes more than one constituent: Chicago wheat and Kansas wheat. (Base date 1970-01-05)

S&P/TSX Global Gold Index - S&P/TSX Global Gold Index is designed to be a dynamic international benchmark tracking the world's leading gold companies and aims to offer investors broad exposure to the world's gold markets. This index reflects S&P's change of the S&P/TSX Capped Gold Index to the Global Gold Index methodology. The intention of the Global Gold Index is to provide an investable representative index of publicly-traded international gold companies. (Base date 1997-12-31)